THE IMPORTANCE OF CONTEXTUAL FACTORS ON THE ACCURACY OF ESTIMATES IN PROJECT MANAGEMENT

An emergence of a framework for more realistic estimation process

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Submitted for the degree of

Doctorate in Business Administration

School of Management

University of Bradford

2014

Abstract

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Keywords: project management, estimation process, estimation framework, estimation technique, estimation-related risk, knowledge-based estimation, project scheduling, critical chain, buffer management.

Successful projects are characterized by the quality of their planning. Good planning that better takes into account contextual factors allows more accurate estimates to be achieved. As an outcome of this research, a new framework composed of best practices has been discovered. This comprises an open platform that project experts and practitioners can work with efficiently, and that researchers can develop further as required.

The research investigation commenced in the autumn of 2008 with a pilot study and then proceeded through an inductive research process, involving a series of eleven interviews. These consisted of interviews with four well-recognized experts in the field, four interviews with different practitioners and three group interviews. In addition, a long-running observation of forty-five days was conceptualized, together with other data sources, before culminating in the proposal of a new framework for improving the accuracy of estimates.

Furthermore, an emerging framework – and a description of its know-how in terms of application – have been systematically reviewed through the course of four hundred twenty-five days of meetings, dedicated for the most part to improving the use of a wide range of specific project management tools and techniques and to an improvement in understanding of planning and the estimation process associated with it. This approach constituted an ongoing verification of the research's findings against project management practice and also served as an invaluable resource for the researcher's professional and practice-oriented development.

The results obtained offered fresh insights into the importance of knowledge management in the estimation process, including the "value of not knowing", the oft-overlooked phenomenon of underestimation and its potential to co-exist with overestimation, and the use of negative buffer management in the critical chain concept to secure project deadlines. The project also highlighted areas of improvement for future research practice that wishes to make use of an inductive approach in order to achieve a socially agreed framework, rather than a theory alone. In addition, improvements were suggested to the various qualitative tools employed in the customized data analysis process.

Acknowledgments

These acknowledgments are a simple statement of thanks. They are dedicated to those without whom this achievement would not have been possible.

I would like to express my greatest thanks to my supervisor, Dr Zahid Hussain, for his patience and encouragement to remain focused in the process of developing this work. His adaptability and willingness to help characterized this fruitful cooperation.

Thanks also to the companies that directly or indirectly supported this project, both offering the opportunity to gather experience in the project management field and generating possibilities to observe as well as conduct interviews. My greatest appreciation of cooperation is addressed to ODiTK Group Sp. z o.o., Progress Project Sp. z o.o., Gruner + Jahr S.A. and Norman Bennett Group. Without their presence, support and involvement this project would not have been possible.

Finally, I would like to share a great appreciation of my wife: you were the source of tolerance and a source of energy, teaching me how to balance contradicting priorities. Your holism in understanding the path of life was a reason for my harmony. Without your presence this project would never have been accomplished. You were and you are our yacht tactician …

Dedications

To You …

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List of acronyms

BM	buffer management
CAQDAS	computer assisted qualitative data analysis software
CCM	critical chain method
CPM	critical path method
DBA	Doctor of Business Administration
Den	density
ERP	enterprise resource planning
IPMA	International Project Management Association
IT	information technology
KM	knowledge management
KPI	key performance indicator
ODiTK	Consulting and Executive Training Centre
PERT	program evaluation and review technique
PM	project management
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PMM	project management methodology
RM	risk management
Sig	significance
TOC	theory of constraints
WBS	work breakdown structure

Publications

Lazarski, A. (2010a). *A study investigating the impact of different contextual factors on the quality of estimates.* Unpublished paper delivered at Conference: 'International Project Management Institute Congress', Warsaw, 09/10.

Lazarski, A. (2010b). *Influence of motivation factors on tasks duration estimation process – is Goldratt always correct?* Unpublished paper for newsletter: 'Project Management Institute – Munich Chapter', 04/10, pp. 8-13.

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1 Introduction and overview

1.1 Introduction

In this introductory chapter, the researcher considers the inherently social nature and characteristics of projects and project management (PM), focusing particularly on the importance of the estimation process and the influence of a project's wider context on this process. The terminology employed in the research is defined, including reflections on just what constitutes a "project", and the researcher's motivations for undertaking this work are also described. Most significantly, the goal and objectives, potential contributions and underlying assumptions of the research project are discussed, together with one of its most important aspects – given the title of the research, i.e. the project's own context and the characteristics that derive from this. In addition, the overall shape and content of the project, and the flow of its constituent parts in order to create a logical, cohesive whole is summarized in Figure 3. The chapter concludes with an account of the considerable work the researcher has undertaken to ensure that the research is publicized and promoted in an appropriately social manner within the PM community itself.

Social characteristics and the importance of estimating

Projects appear to be socially constructed. "Project and project management are 'invented not found.' It is us, all of us, who if reflecting on practice, are inventing the discipline." (Morris 2013, p.15). These words characterize the view of the researcher when it comes to explaining both the potential source of own confusions and the preparedness to contribute to the business knowledge and science of this field.

The estimation process in PM is vital to many business activities. It could relate to time, work effort, costs or resources. According to the Project Management Institute (PMI), estimating is an important part of planning and is therefore critical to budgeting and both planned and executed project cash flow. Typically, in planning, "defining activities, estimating activity resources, estimating activity durations and developing the schedule model are so tightly linked that they are viewed as a single process" (PMI 2013, p.142). Thus improvement in the accuracy of estimates should contribute to better business practice. The ambition of the researcher is not to discover the new holy grail of methodologies but is rather to stimulate the interest of practitioners in the promotion of a new approach toward the problem of inaccurate estimates.

Context as the bedrock of anticipated framework

This research project examines the importance of project context on the accuracy of project estimates and, as a result, generates a new framework for improving the accuracy of estimates to encourage a more broad-based view within PM practice. For the purposes of improving estimation accuracy, the research aims to identify useful tools and techniques and determine their application by way of contextual factors, such that usage of particular tools is governed not just by the choice of a specific project management methodology (PMM) but also by a project's contextual circumstances.

The reader is thus encouraged to stop thinking in terms of a choice between PMMs. The cognitive process leads to a framework that is configurable to context and open to further development, and shifts attention away from PMM labels. Practitioners can then make direct use of project context itself. This idea is depicted in Figure 1 where the configurable link between "roots" and "leaves" could be identified.

Figure 1 Tree of relationships – a process to develop a configurable link between "roots" and "leaves"

Being context-dependent, the guidelines for this framework should assure its ergonomic applicability and usability. Moreover, a reduction in sensitivity to the influence of PMMs, may be considered a valuable contribution to PM practice.

The chosen approach and modest scepticism

The nature of this research project calls for exploration, inductive reasoning and a more qualitatively organized scientific investigation. An interpretivist- and constructivist-oriented approach is applied in an inductive way to make sense of this complex topic. In support of the framework development process, an inductive approach is employed. However, it must be emphasized that the purpose of making use of the mentioned methods is solely to exercise their capability for effectively managing the formulation of a new framework. It should not be assumed that the researcher intends to propose a new theory.

To further temper the research process, a small-scale pilot study was undertaken and is presented in Section 4.3. Its main purpose was to verify whether a project-induced pessimistic experience and the intentional reduction of project estimates only leads to subsequently observed overestimations of activities. Moreover, a pilot study delivers insights that help to determine whether this research project should be conducted more qualitatively with the focus placed on induction and exploration.

Within the whole research process, the selection of interviewees and observations is aimed at enriching the understanding of the relationship between a project's contextual factors, the practices concerned with the accuracy of estimates, and the planning process in general. Furthermore, to assure a socially agreed understanding of findings, a wide verification against the views of various PM community members and practitioners must be conducted.

There is some scepticism in regard to the applicability of the final results. Indeed, the total elimination of bias in estimation may not be possible. Moreover, the researcher, in seventeen years' experience in the field, largely witnessed (Cottrell 2005, p.142) opportunities to apply mainly branded PMMs. The idea of the framework proposed should have come to the marketplace much earlier. It is common during business meetings and conferences to hear the phrase – "context is king". If context really is so conspicuous, why is its consideration not already more ubiquitous, hailed and promoted as good business practice? The most recent trends in PM-reconstruction remind us that PM "is, as we've seen, a social construct" (Morris 2013, p.23) and thus, logically, contextual focus should be an established starting point for many projects.

1.2 Introductory definitions

Some of the terminology used in this research project should be explained in order to avoid misunderstandings or misleading conclusions. The reader's own paradigms and experiences may subconsciously throw up definitions that do not necessarily correspond to those used in this research.

1.2.1 Project management

The history of PM is quite a modern one. It was not until "1952–1953 that the concepts and tools that a modern project manager would recognize as characteristics of the discipline were invented" (Morris 2013, p.7). PM is defined as "the application of knowledge, skills, tools and techniques to project activities to meet the project requirements" (PMI 2013, p.5). The present research considers there is, among such requirements, one that requires that estimates should be trustworthy.

1.2.2 Project

A project is “a temporary endeavour undertaken to create a unique product, service or result” (PMI 2008a, p.442). It becomes clear that a lack of repetitiveness is an important characteristic of a typical project. Therefore, a project is not a repeatable process. At the same time, the definition does not designate that the project should be unique but rather that the uniqueness relates to its products, services or results. The definition links uniqueness to what the project delivers and it is a mistake to suggest that the project is, in itself, something unique.

1.2.3 Deliverable

Each project is expected to deliver internally and externally, and this happens throughout its lifecycle. A deliverable may be characterized as “Any unique and verifiable product, result, or capability to perform a service that is required to be produced to complete a process, phase or project.” (PMI 2013, p.84). It is a keyword that serves to eliminate unnecessary confusion when discussing a project’s outputs. Deliverables can be partial, interim (PMI 2013, p.102) or final (PMI 2013, p.103). An estimate may thus be understood to be a deliverable, having all the characteristics and requirements typically associated with them.

1.2.4 Stakeholder

A stakeholder is defined as an “individual, group, or organization who may affect, be affected by, or perceive itself to be affected by a decision, activity, or outcome of the project” (PMI 2013, p.563). This definition leads to an interesting conclusion that the planning process maintains a connection between an activity estimation process and the stakeholders. Thus, it may be necessary to gather data (PMI 2013, p.563) in order to decide, through a process of stakeholder analysis, which particular stakeholders’ expectations should be considered during the project lifecycle.

1.3 The relationship between process and project management

After parsing definitions of “project” and “deliverable” it is possible to conclude that no project should be considered unique in terms of anything other than its deliverables. A company could potentially develop its business processes in such a way as to reduce the uniqueness of its projects. Business processes support projects and if they were to be more standardized and repetitive, they could allow projects to be estimated with greater accuracy.

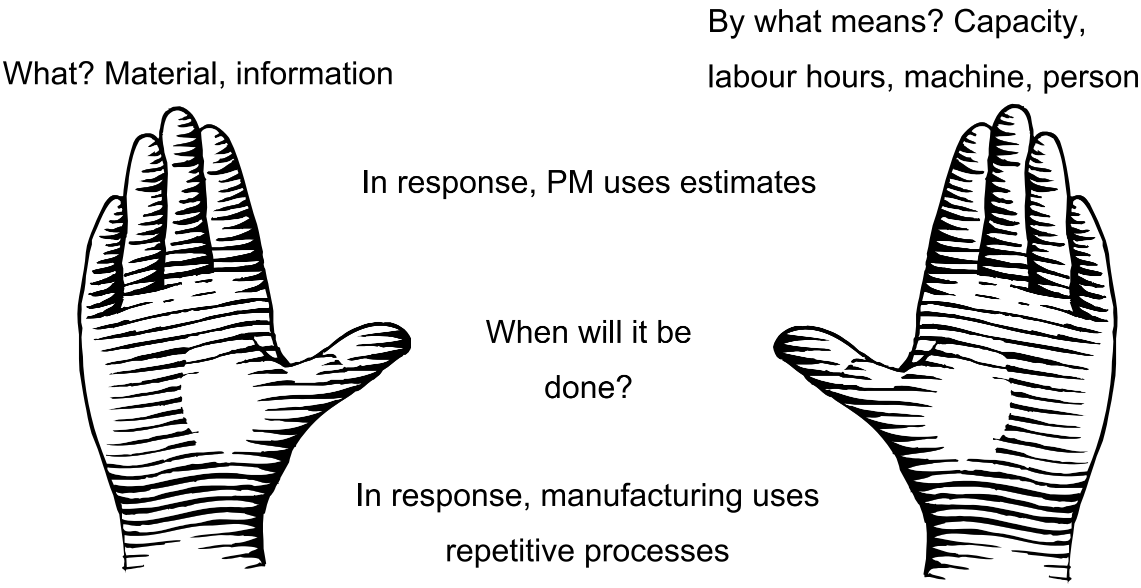

Figure 2 The repetitive world and the “estimated” one of PM

However, as depicted in Figure 2, a project should not be considered to be a process. It would be a very unfortunate mistake. A typical project is characterized by an individually estimated schedule which is quite different to the course of repetitive production. Nevertheless, repetitiveness can ensure the availability and use of historical data in order to increase the accuracy of activity estimations. If the underlying business processes were more reliable, then the overall sum of activities could also increase in accuracy. This sum of activities would in turn give rise to a schedule, representing project through estimates that are considerably more accurate.

1.4 Motivation to undertake the research and potential contributions

The main sources of motivation to undertake this research project were the researcher's practice related to project buffer management (BM), reflections on project definition, ongoing academic discussion, active PM community participation, and the observation of PMMs and the PM “guru” phenomenon and their influence on the PM community. The researcher’s curiosity was also stimulated by an awareness of the importance of the planning process and its contextual characteristics. In PM "failing to plan is planning to fail" (Kerzner 2000, p.412). Potentially, if a way could be found to increase the accuracy of estimates, then the typical problems associated with budgeting and scheduling would decrease. This achievement would be a clear contribution to improved business practice.

1.4.1 Motivation and rationale to undertake the research project

Literature perspective

As presented in Chapter 2, the specificity of ongoing academic discussions of the subject must be considered as one of the vital elements motivating to investigate further into the phenomenon of inaccurate estimates. In brief, it can be argued that many research papers tend to focus on estimating models that are locally valid, and not on more open frameworks. Multi-use approaches are scarce, and project context is mainly treated as a structured, predefined description and not as a basis to help reconstruct, from one project to another, a methodological solution. Researchers often prefer to emphasize the use of more traditional PMMs or agile-oriented approaches, rather than searching for a consensus between different PM communities while recognizing the variety of contextual configurations possible.

In the ongoing discussion, the execution phase often becomes more important than operations at the project’s front-end. The use of knowledge is valued, yet the investigation into knowledge-related risks is rather limited. Writers tend to focus on underestimation, as for example within the public sector, or on overestimation, as a result of pessimism-inducing experiences, rather than discussing the single-project coexistence of these two phenomena. Moreover, they prefer to consider the macro-scale – a generalized, summarized view –

rather than the micro-activity level where this duality can be better observed, and where the complexity of the project becomes the focal point of the investigation.

Finally, there are groups of papers that either advocate or criticise particular “gurus” of PM, and as a result of this academic “battle” the scope of debate is narrowed. Following on from this are social movements reminiscent of marching armies with contributions (not necessarily of the highest quality) which further compound our discussion of the complexity of business practice. To summarize, it suggests a need for more contextually open research into the problem of inaccurate estimation in PM that is less oriented to a single case or business sector; research that is focused more on activities and which considers both overestimation and underestimation.

The importance of deliverables

Project deliverables have the potential to influence the future cash flow of companies. A smaller estimation bias within budgeting, scheduling and many other related planning activities could help to produce more reliable deliverables. Then, with better-estimated projects, shareholders may be more likely to invest their assets into new ventures, while anticipating less volatility between the planning and execution of projects.

To explain this relationship, the researcher asked “do you have to get old to become rich”? If a joint-stock company runs projects, then the stock exchange discounts the future cash flow of these projects to its present value. Discounting future cash flow also increases the present value of shares by dint of project predictability. This could be readily demonstrated since there are many examples of rapidly growing companies (in terms of value), thanks to new, unique, innovative and verifiable projects.

In another example, the project deliverables accomplished may be used to evaluate and grade past projects. However, what if those deliverables, when previously planned, had been either overestimated or underestimated? Basing lessons learned on the deliverables achieved might be misleading if such an estimation bias goes undetected.

The contextual nature of PM and the impact of PMM

PM knowledge “is similarly contextual. It is affected by industry practices, technology, environment, personalities and so on” (Morris 2013, p.17). Contextual topics seem to be ubiquitous in the realm of PM. Why is it then, that “no conceptual model currently exists that enables project managers to understand why different approaches exist” (Pich et al 2002, p.1008)? What benefits might PMMs bring to projects and organizations? Wells (2012) informs us that within information technology (IT) there was no empirically supported, related research available. It could be assumed, therefore, that the present research represents one of the first attempts to answer the question posed by Pich et al (2002).

A few years ago, during a conference, the researcher was asked the question “what is the best planning approach in PM?” The question was in relation to a brand-named methodology. Finding a tactful answer required several seconds: “a lack of necessity to plan”. The researcher was suggesting that, faced with more accurate estimates, it may be less necessary to apply corrections or to intensify a potentially costly planning process. After all, the planning process may be considered as a part of the larger process group (PMI 2013, p.3) and to “occur throughout the project” (PMI 2013, p.3), and if it is overused it is likely to be an expensive task.

The likelihood of realizing the research project objectives

Before and during the research project, the researcher’s motivation and curiosity were mainly supported by practitioners and organizations working in the field of PM. These relationships were maintained at both an educational and a business level. It helped the entire research project to become a source of valuable reflections and self-development. Thus, for example, working with practitioners allows the delivery of “regular feedback on progress, problems and outcomes” (Robson 2002, p.13).

The data that is collected reminds us that at the “heart of the dissertation is the story of what took place” (Coghlan and Brannick 2005, p.128). Thus, access to experts, PM-focused companies, project cases and other valuable data was obtained. It seems that the most interesting aspect was the knowledge that practitioners and experts in the field were able to share.

However, and perhaps somewhat pessimistically, the “reality of project management is that you never really have the time to create the perfect plan” (Chin 2004, p.10). But is it necessary to struggle for perfection? The goal is rather to better understand the importance of contextual factors in PM, the processes related to them and their influence on the accuracy of estimates. It should be possible to propose a new, open framework that gives more realistic and less biased estimates.

1.4.2 Synopsis of potential contributions

At this stage the expectation is that the project will achieve the following:

1. For research and business theory.
    a. The prospect of a shift from the scientific paradigm characterized by many PMMs to a more contextual one. To initially depend in the planning process on project context and not on PM associations or branded methodologies, specifically in the choice of tools and techniques. At present, there is little consensus in the approaches promoted by PM associations (Morris 2013, p.16).
    b. A deepening of the study of contextual factors that give rise to underestimation or overestimation in project activities and the project itself.
    c. A reconsideration of the approach to the concept of BM within the critical chain method (CCM) (PMI 2013, p.178). Placing the focus only on the problems of overestimation and the factors creating a positive/inflated buffer, safety margins may be challenged. The question remains – if while managing underestimation a negative buffer existed, could this coexist with “standard” inflated buffers?

d. An enhanced study into the nature of knowledge management (KM) and the lessons learned that are collected through the execution of projects. Does an increase in knowledge automatically result in an increase in the accuracy of estimates? Alongside the "value of knowing", is there a "value of not knowing" present too?
e. Additional insights into the contribution that a pilot study might make to research design and final analysis.
f. The opening up of possibilities for future research projects which could aim for the formulation and verification of a theory taking its starting point from the basis of the framework derived.

2. For business practice.
   a. To allow the PM practitioner to reduce the need to analyse whether a given PMM is better or worse, and whether specific PMM is having a sort of "right" to define what PM knowledge is.
   b. To make available a framework for estimation improvement that is broadly applicable and open to further adaptation, and which places a focus on project context and the tools to be used. The framework may address methods currently located in a variety of PM approaches, including the more prescriptive PMMs as well as agile and BM focused concepts. Through the framework, the practical use of project context may become feasible.
   c. A greater awareness within a project team of the use of KM to achieve projects less prone to inaccurate estimates, to support the team's early project involvement, and to use knowledge to contribute to further framework adaptation.
   d. The identification within the framework of a number of tools, techniques and practices creating in itself a unique, configurable composition that makes a practical contribution to the conclusions regarding improvement in estimation process.
   e. Better estimated schedules, budgets and labour demands, thus enhancing the predictability and trustworthiness of a project's future cash flow and so protecting a project's present value to encourage investors.

f. A refreshed view on securing project milestones, achieved both by improving accuracy of estimates and developing new perspectives through the use of project buffers that have been analysed more reliably.

1.5 Research assumptions, goal and objectives

This section elaborates further on the purpose of the research project. The principal goal of this study depends on four specific assumptions and is supported by five research objectives, all described in this section. These objectives are also addressed further within the literature review and methodology chapters.

1.5.1 Research assumptions

In order to better understand the research strategy adopted, the assumptions underpinning it should be presented.

1. A project’s contextual factors can be more important in the understanding of PM complexity than the influence of any predefined PMM.
2. A project’s contextual factors can be associated with many of the tools and techniques already present within various PMMs.
3. The same or similar tools and techniques tend to reappear in different PMMs.
4. The research project should not be constrained to any specific industry or business sector since the framework derived should be open to testing and development in a variety of projects. Reliance on only one specific business sector could, from the outset, contextually narrow the scope of future discussions and so limit the potential for further contributions.

1.5.2 Research goal

The research's title emphasizes the importance of contextual factors on the accuracy of estimates. Estimation is regarded here as a part of the planning process (PMI 2013, p.143). The inductive character of the thesis relates to its main goal: the expected formulation of a new framework to support improvement in the accuracy of estimates. This element of the overall goal is captured within the second objective.

Such a framework should allow project managers and project teams to better understand project front-end activities and what tools to apply in various contextual situations. This could become a new way to deploy tools and techniques in PM which could, potentially, even "shape and modify the project's characteristic" (Morris 2013, p.18) as a response to the project context analysis itself.

1.5.3 Research objectives

The objectives of this research project can be represented as a logical sequence to be followed. Addressing the first of these is, however, preceded by the whole conceptualization process presented in Chapter 5. Together, the first objective and the conceptualization within Chapter 5 create the fundamentals for the second objective – the framework. The second objective thus introduces the framework, provides a major aspect of the project's goal, and focuses strictly on the conceptualized network and recognition of its dependencies, contextual dimensions and concepts as indicators to particular tools and techniques. These first two objectives constitute the core explorative process which follows in Sections 4.6 and 4.7 presented, the data collection and analysis process.

The last three, subsequent objectives build on the findings previously induced and complement the overall discussion. Furthermore, in the case of the fourth objective, an additional contribution and supplementary discussion is furnished by the pilot study which preceded the main research process. The objectives and the planned sequence in which they are to be achieved is thus as listed below:

1. To provide a better understanding of contextual factors causing overestimation and underestimation. This objective is primarily associated with the assumption that overestimation is a significant and commonly observed problem, especially when considering the individual estimates provided by project team members. A better understanding of the underlying duality of this phenomenon forms the basis for the second objective – the framework. Before this is developed, it should be clear exactly which characteristics of an estimate's volatility can be productively challenged.
2. To generate a new framework supporting a more realistic estimation process in order, for example, to increase the chances of accomplishing project activities to a specific estimated deadline. This objective directly supports achievement of the project goal. What is unique is that this framework would take advantage of contextual factors to determine the appropriate use of specific PM tools and techniques. It would emphasize the estimation process but it may also address other planning elements. Such an approach should better correspond to business practice since the framework could be considered as providing a configurable "solutions" to the project context as well as being open to further adjustment and development. Of course, it might be considered a failure to induce a framework, perceived as another prescriptive methodology, when there are already around one thousand other named PMMs (Wells 2012, p.45).
3. To respond to whether an increase in knowledge is always helpful in increasing the accuracy of estimates. KM practice seems to offer inherent support to increases in experience and in general, tacit knowledge of PM (Gemino et al 2015; Wells 2012). Is this so self-evident when it comes to reducing bias in estimation? Given that levels of knowledge and experience may be considered by some to be too low in many situations, could it also be considered to be too high in some others?

4. To verify whether the BM concept, as it is widely understood and practiced, can be broadened. In the securing of a project delivery date, buffers are used to represent estimation bias and to manage uncertainty, safety margins (PMI 2013, p.178). The CCM "stands" on two "pillars" – one is management by constraints, and the other is BM. Somewhat unexpectedly, in this context, BM is explained in terms of an inflated estimate. Should it also consider, if present, an underestimation? And if underestimation should be considered, could it imply a standard obligation to re-discuss the project delivery date, especially while being *a priori* to planning that is required to deliver to a specific project deadline?
5. The last objective is dedicated to the discussion of whether to advise a PM practitioner to focus on techniques for improving accuracy of estimates or, instead, on techniques to manage an expected lack of accuracy. For example, the PM community routinely faces the associated debate as to whether traditional methodologies or more dynamic/agile-related ones are more applicable. What is more, it is known that PM associations, do not necessarily search for any consensus on the subject of PM (Morris 2013). This objective also represents an attempt on the researcher's part to remain self-critical in the light of the findings revealed.

The specification of steps on the way to explaining how the objectives were to be accomplished is summarized in Figure 3, which also serves as a map to maintain links to various parts of this document in which more detailed information is provided. Thus, the research strategy applied in terms of the cognitive process to meet the objectives is depicted in Figure 11, and a more detailed description that list the steps in the development of this cognitive process is shown in Figure 12. In addition, in the literature review chapter a critical analysis of papers indicates PM knowledge gaps and how they relate to the set of objectives above. The presentation of findings can be found in Chapter 6, with summary and conclusions appearing in Chapter 7.

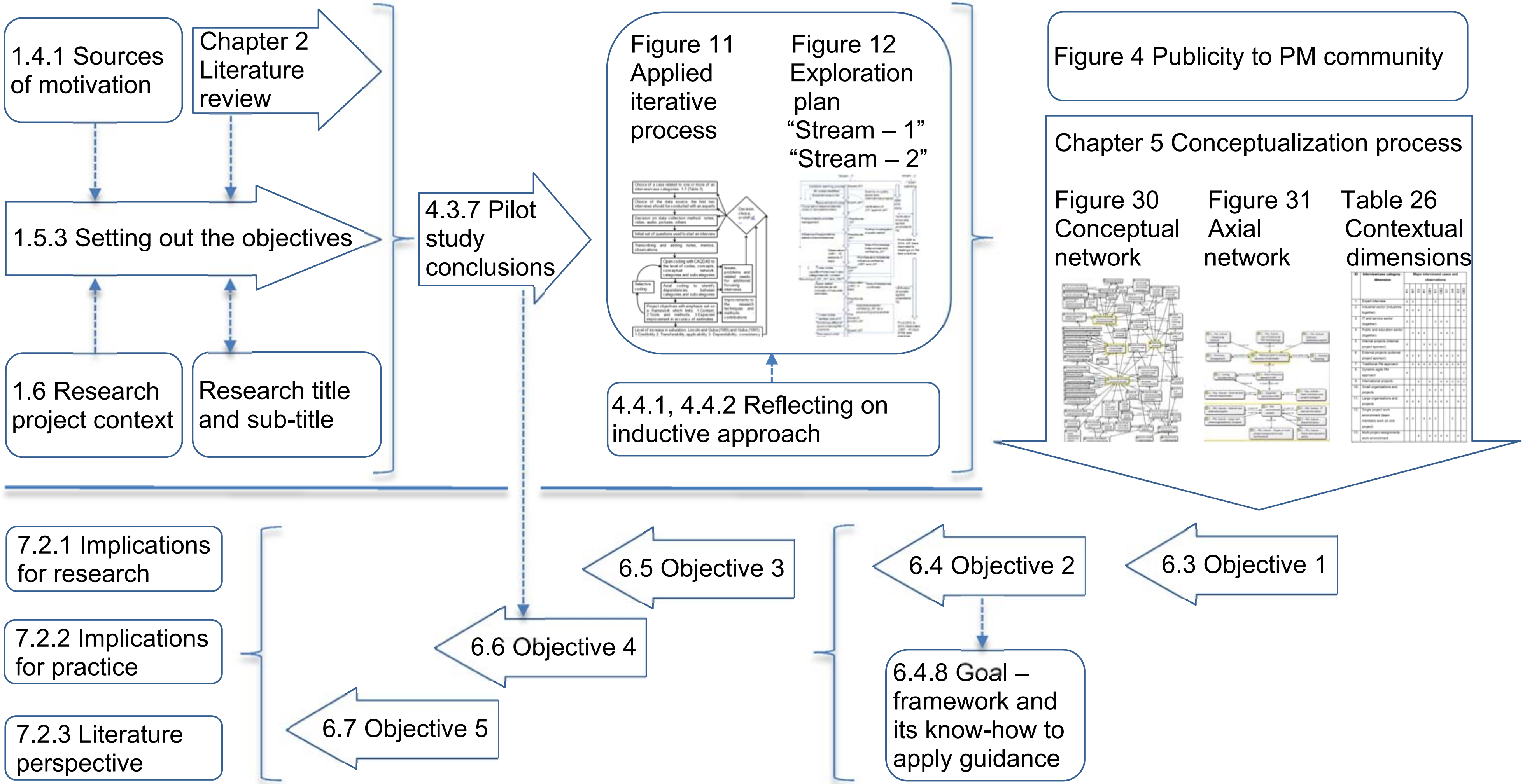

Figure 3 Generalized map specifying steps in meeting the project aims

1.6 Research project context

To avoid the pitfalls of “pre-decision on method or technique” (Robson 2002, p.57), the context of this project should itself be discussed and evaluated. This research project is a case of PM too. It depends on its own contextual factors and should therefore align to or manage them, not contradict them. For example, some contextual factors may support or hinder the application of certain research methods. This section provides a view of selected contextual factors typical to this research project.

1.6.1 Own experience

The researcher now has seventeen years of consulting, mentoring, business training and running projects behind him. He also has responsibility for the preparation for the certification process offered by the PMI and the International Project Management Association (IPMA) associations. Through these activities he has a number of opportunities to establish new business relationships which could be useful to support the research process.

These relationships may quite often bring exposure to “problems that are not in the book” (Schön 1991, p.64) and, as a result, may increase the validity and practical business applicability of the conclusions reached. Indeed, that “reflection-in-action hinges on the experience of surprise” (Schön 1991, p.56), and the thesis’s contextual situation allows many opportunities to reflect on a topic in this way.

1.6.2 Feasibility of collecting data and risk of bias

The researcher works for many different industrial and service sectors, ranging from small companies to international corporations. This confers contextual alignment and advantage since the research’s title seeks not to constrain the issue under consideration to any specific business sector.

In addition, there is another contextual factor related to the researcher's unbiased standpoint – sponsorship. Sometimes, "scientists are seen as providing information potentially biased to suit their sponsors" (Robson 2002, p.17). However, this research was financed solely from the researcher's own private funds. It should be stated that the researcher's professional occupation affords a great number of opportunities to investigate the subject but it also facilitates the majority of related costs.

Choosing a research strategy that is consistent with a project context may mitigate negative risks (PMI 2008a, p.303), such as the potential for a subsequent shift in topic or the approach applied. In terms of the potential research designs available, the context of a research project will favour some and limit the use of others, and the feasibility of their application is discussed in Section 4.2.

1.6.3 Publicity and promotion of the topic

Figure 4 depicts the major process of promotion of the research topic to the PM community. It also indicates the level of communication engagement maintained with practitioners and experts. The researcher mainly used conferences, newsletters, journals, public presentations and speeches to this end. Additionally, in the spring of 2014, a contractual agreement was reached to promote the induced framework to the market.

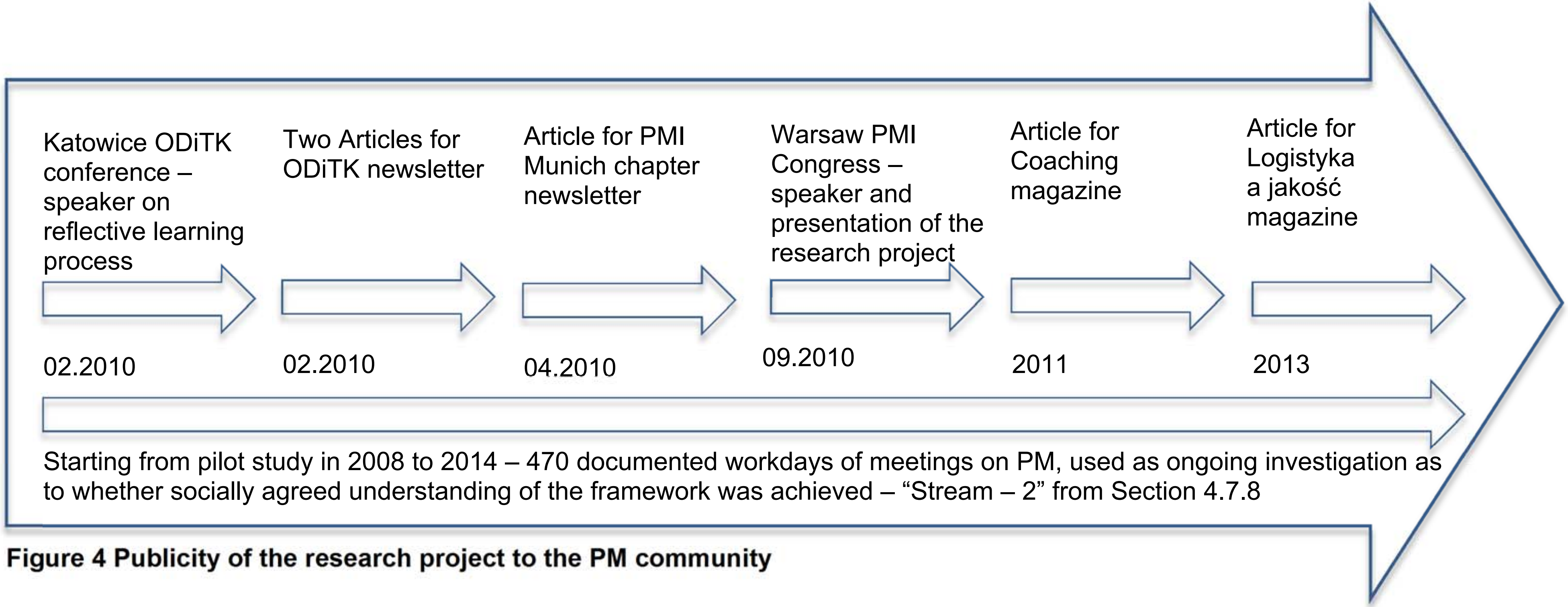

Figure 4 Publicity of the research project to the PM community

1.7 Conclusion

This chapter has described the assumptions and objectives of the research. It articulated a commitment to a better understanding of how to increase the accuracy of estimates in the realm of PM. It briefly discussed the importance of estimation in day-to-day business practice and suggested that project context can be more important than any given PMM, when it comes to promoting a better understanding of the relationship between project context, the tools used and the accuracy of estimates. The invention of a new methodology was not defined as a target and it should be noted that some scepticism with regards to achieving totally unbiased estimates was described.

In the following chapters, PM terminology is frequently used and it was necessary, therefore, to clarify understanding of specific definitions. A major “globally recognized standard” (PMI 2013, p.1) was used as the source for this, with definitions of PM, project, deliverable and stakeholder all being discussed.

On the basis of the terminology, the differences between repetitive processes and the unique characteristics of deliverables, rather than projects, was briefly elaborated upon. It was suggested that project uniqueness cannot be concluded from a project’s definition and, therefore, that uniqueness should not be recognized as a conspicuous project characteristic. Project deliverables were presented as influential to the present value of a project’s future cash flows. This link between the project and present value seems to also be dependent on the quality of the planning process and estimation. This reflection reinforced the need to increase the accuracy of the estimation process.

Ongoing motivation was stimulated by maintaining contact with PM practitioners and the PM community who both regarded this research with interest. Socially agreed understanding became an element of the verification during the 470 days of thematic meetings conducted, supplemented by the opportunity to deliver presentations during PM-related conferences.

The phenomenon of social movements and the following attached to various PM "gurus" has resulted in business practice being dominated by project buffers characterized by assumptions of overestimation. However, context-sensitive PM may place an understanding of both overestimation and underestimation within reach, and the desire to find cases which will also explain the practice of underestimation is growing.

Furthermore, the work of Morris (2013), Morris and Geraldi (2011) and Wells (2012) proved a source of strength in reinforcing the commitment to achieving the goal of this research project. Their papers, among others, indirectly argue that there is no need to define a new methodology. Contextual awareness and tacit knowledge may address theoretical gaps and may support methodological areas not yet covered. Practitioners often depend more on their own experience than on any PMM. These arguments are among the reasons why a multi-use framework, linking context and tools, became a major goal of this research.

In the process of defining the goal and objectives of the research project, the intention was to remain self-critical and to apply risk management (RM) principles. The final objective is therefore dedicated to better understanding whether a PM practitioner should commit any effort at all to increasing the accuracy of estimates. Are there situations where it is not meaningful to increase accuracy but better to simply manage, avoid or ignore unavoidable bias? It is hoped that such a considered approach may render the whole framework less prone to criticism of its practical applicability. The next chapter critically reviews the associated literature and discusses it in reference to the research project's objectives.

2 Literature review

2.1 Introduction

This chapter focuses a critical eye on ongoing academic discussion, studying it from the viewpoint of accuracy of estimates and in relation to project context. It reflects on tools and techniques promoted by available PM standards. In addition, it highlights gaps in knowledge which become visible in the course of discussing the direction of existing academic investigations. Initially, these literary traits were raised in Section 1.4.1. The researcher also attempts to use literature analysis to better justify the choice of the research objectives.

Additionally, the reasons for the existence of a practically unlimited file of potential project contextual factors are explained. Problems, thinking patterns, conflicting paradigms or sources of confusion are indicated. Among them, traditional and dynamic approaches in PMMs are differentiated. Reflections related to BM are addressed and current PM trends are debated.

It is important to recognize that due to the inductive character of this research project, the purpose of analysing the literature is not to formulate a hypothesis or to identify the most valid present model, e.g. framework. Rather, it serves to recap scientific investigations from a critical perspective. It also helps to retain focus and to formulate, as presented in Table 4, initial interviewing questions. Additional discussion of the literature in conjunction with the findings takes place in Section 6.8 and is summarized in Section 7.2.3.

2.2 The phenomenon of PMMs

There are various PMMs available on the market. PMI offers Project Management Body of Knowledge (PMBOK) – the one that has become a basis for the International Organization for Standardization, 21500:2012 standard. On the other hand, there is also Projects in Controlled Environments (PRINCE2), which is to some extent more prescriptive. Finally, the youngest organization among those mentioned, IPMA, also offers a methodology. There are other approaches available too, and the list could be extended (Wells 2012). Some of these would be regarded as traditional in nature, some as more dynamic/agile.

It all brings considerable confusion as members of each PM association may claim superiority of their methodology over those of their competitors. Some writers become, to a certain extent, tired of these issues and simply claim that “it may sound like blasphemy, but methodology doesn’t matter” (Fewell 2010, p.27). It is apparent that professional PM associations present a “lack of consensus in their views” (Morris 2013, p.16). Not surprisingly, “in practice, the level of adherence to standards is effectively devolved between client and provider” (Johnson 2010, p.270).

According to the definition offered by PMBOK, PMM is “a system of practices, techniques, procedures and rules used by those who work in a discipline” (PMI 2013, p.546). Does this indicate its straightforward applicability in order to improve the accuracy of estimates? Unfortunately, it is not possible to find specific documents’ layouts, software tools, discussion of the most and the least important practices all together in one place. Generality persists. Additionally, it seems that PM associations avoid being linked to any one business sector. It is speculation but maybe being general helps to address a broader clientele?

In addition, “critical schools” are emerging (Hodgson and Cicmil 2011). According to their approach, there is no universal project with a common characteristic. There, a project does not have “essential characteristics to be discovered and described independent of its context” (Oellgaard 2013, p.65) or of its company (Kerzner 2014). These thoughts call for contextual awareness and may constrain, to some extent, the use of prescriptive PMMs.

2.3 Project context and accuracy of estimates – the first and second objectives

2.3.1 Project context-driven perspective

The first project objective calls for investigation into contextual factors causing underestimation or overestimation. It favours a contextual perspective rather than tying itself up with consideration of available methodologies. Understanding project context "helps ensure that work is carried out in alignment with the goals of the enterprise and managed in accordance with the established practice" (PMI 2008a, p.17). This sounds promising. However, methodology does not turn this into practical know-how to be applied.

In another example, also concurrent with mainstream PMMs, Lester (2014, p.59) recognizes the duality of estimation bias and, typically, applies tools and techniques. However, again, he avoids discussion of details of project context, triggering the use of specific tools for improvement of accuracy of estimates. Such a viewpoint could address the question: "Are projects best managed by rigidly enforcing every detail of all the processes, or by drafting a completely custom process for each and every project?" (Fewell 2010, p.27).

Furthermore, the importance of the first objective finds its confirmation in the work of Atkinson et al (2006). There, within broad discussion, they investigated more "fundamental uncertainties of projects and the scope of project management" (Atkinson et al 2006, p.696). Projects were presented as "social processes requiring ongoing construction" (Atkinson et al 2006, p.696). However, they did not investigate in depth the sources of uncertainties or duality in estimation bias but indicated the need to reduce uncertainties and related it to the process of estimating, project parties and project life cycles. Researching into optimism bias, Meyer (2014, p.8) admits that being responsible for forecasting and estimating, the decision maker, among others, takes into account contextual factors. Unfortunately, this paper did not consider pessimistic bias but rather focused on the point at which the decision is taken to terminate failing projects.

Another interesting piece of work that prefers to classify deviations as manageable or unmanageable informs us that "research addressing deviations in product development are surprisingly scarce" (Munthe et al 2014, p.213). Even though limited to one type of project, it is interesting that this work considered deviation as an all-visible process rather than the result of unexpected events (Geraldi et al 2010). The researcher's approach could be considered to be similar, although it is broader and not limited to the contextual situation of product development. On a similar subject, such discussion was also supported by Yang et al (2014). The contribution of this paper seems to be more significant but is still confined to product development and is more willing to discuss uncertainty and ambiguity (Yang et al 2014, p.836) rather than the direct causes of overestimation and underestimation.

Typically, literature associates the problem of bias in the estimation process with particular business sectors, e.g. the public sector, or provides locally valid models and tools. This constrains the reconfigurability of conclusions from one project to another or from one organization to another. For example, Yang et al (2013) focused on the main causes of the "schedule delays in construction projects" (p.21) identifying local, contextually valid sources of delays. Moreover, their discussion does not take into consideration the duality of bias. Causes of delays are often discussed through macro-project conclusions, which are less detailed and do not allow for a deep discussion at micro-activity levels. Is there room for activity underestimation even if the overall project appears to be overestimated?

A discussion paper by Aliverdi et al (2013) also focuses mainly on one specific tool and only on construction projects. Again, Riquelme and Serpell (2013, p.73) bring analysis rooted in the construction sector. However, they identify contextual qualitative factors and use them as triggers within their approach to improving accuracy of estimates. However, they did not explicitly investigate the duality of estimation bias. An interesting, wide-scale investigation was conducted by Azman et al (2011), which again was limited only to the construction sector. It should be noted that in this paper they did discuss the duality of overestimation and underestimation. They did not focus only on an underestimation perspective as, for example, did Flyvbjerg et al (2002b). Unfortunately, Azman et al (2011) preferred mainly a macro-project, bid-based perspective of analysis. Shi and

Blomquist (2012) focused on the interesting niche problem of estimating the overlap of activities without, unfortunately, paying much attention to various contextual structures.

Finally, some authors even claim that, within the estimating and planning processes, it is possible to achieve generalization on the basis of just one business sector. For example, Peters (2015, p.ix) claims that “if you can do it within oil, gas, and petrochemical sectors, you can do it most anywhere”.

2.3.2 The unlimited file of project contextual factors

It seems that in real life the application file of project contextual factors may be unlimited and thus problematic in its management. “Enterprise environmental factors refer to conditions, not under the control of the project team, that influence, constrain or direct the project” (PMI 2013, p.29). These factors could, therefore, be considered to be part of the project context. Some of them would be internal or external “that surround or influence a project's success" (PMI 2008a, p.14). They “are not limited” (PMI 2013, p.29) and thus in practice they may become an endless file.

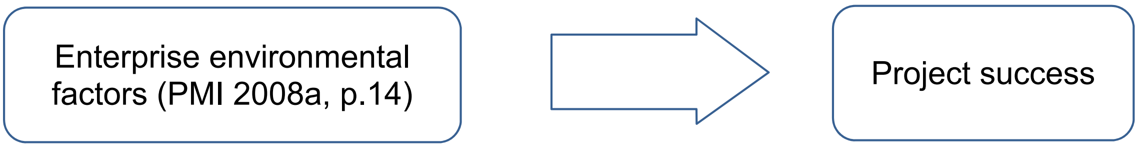

Figure 5 Enterprise environmental factors influencing project success

In addition to what is proposed in Figure 5, the file of contextual factors could only be extended by adding new literature sources or various project cases and examples. A research situation characterized by a practically unlimited number of contextual factors is freshly considered in Chapter 4, upon development of an applicable research design.

In summary, a scarcity of papers independent of a specific business sector or case, contextually open and aware, considering the continual duality of overestimation and underestimation, and taking the reader to a micro-activity level of analysis in order to improve the accuracy of estimates is evident. Research papers are dominated by topics related to a chosen contextual structure, a particular business sector, promoting one or another estimating tool or a placing a focus at macro-project level where it is easier to recognize overestimated or underestimated projects.

2.3.3 Frameworks supporting a more realistic estimation process

Špundak (2014) concluded that “there is no silver bullet for using project management approach and project management methodology for specific project” (p.946). Potentially, none of the PM practices is the best practice in all project contexts. The second of the research project objectives aims at the development of the framework, which makes extensive use of project context in order to support a more realistic estimation process.

Rethinking PM in pursuit of a more contextualized approach seems to be encapsulated within the most recent trends (Svejvig and Andersen 2014). Thus, a proper approach may be less inclined to use traditional PM-based textbooks and become more practice oriented, implying organizational change (Crawford et al 2014; Hornstein 2015). It would also develop, making use of “continuous learning and the leveraging of experience” (Leybourne and Sainter 2012, p.12) in order to improve the accuracy and better protect project milestones. The question remains as to whether a framework should just “respond” to project context or rather try to assure “interaction between a context that shapes management and a management that shapes context” (Morris and Geraldi 2011, p. 28). In other words, should a framework consider project context only as an input to the process of improving accuracy of estimates or also as an element to be influenced in itself?

Chandrasekaran et al (2015) admits that project and organizational context affects project performance. However, they do not formulate any open framework and confine themselves to research and development projects. Fernandes et al (2014) offer a framework allowing a choice from fifteen PM improvement initiatives. This approach is interesting but is neither focused on accuracy of estimates nor contextually ordered or prioritized.

An interesting piece of work which recognizes contextualized PM practice is provided by Besner and Hobbs (2012a, 2012b). There, context is grouped into archetypes to recognize large and small organizations, and large and small internal and external projects. It is subsequently associated with PM toolsets. Despite the importance of this paper, one criticism that could be made is that the classification of all contextual configurations into five major archetypes might be an oversimplification, especially when compared with the much greater number of toolsets offered within this paper. Might it be possible to initiate a similar discussion without using archetypes but by using individual contextual factors and not toolsets but individual tools?

A number of scholars rely on mathematically oriented frameworks which somehow, through a focus placed on the complexity of tools applied, avoid contextual discussion of their use. Works fitting this pattern could be those offered by Azeem et al (2014) or those even more oriented to program evaluation and review technique (PERT) improvements – the papers provided by Trietsch and Baker (2012) or Trietsch et al (2012). Furthermore, the scope of offered methods considers neural network application to improve software projects' estimates (Lopez-Martin 2015), genetic algorithms (Chang et al 2013), linear programming (Kim et al 2012) or, in the construction sector, even more complex mathematical models (Guerrero et al 2014). Ease and contextual versatility of making use of such frameworks in daily PM practice may be discussed.

On the whole, there are quite a lot of papers which consider context as a vital element affecting project performance. At the same time, it is possible to identify papers which offer various PM frameworks, being focused primarily on specific mathematical models. Again, the discussions often address a specific business sector or a contextually defined situation. It was not possible to identify papers that develop a framework that determines the use of methods through an unconstrained perception of project context. Nor was it possible to identify a framework which considers ease of use and its adaptability and aims to improve the accuracy of estimates.

2.4 The use of traditional and dynamic approaches

Within PM planning practice, two major approaches can be identified. The first considers the bias associated with estimates as a problem which affects deadlines, budgets and deliverables. In this case, methodologies like PRINCE2 or PMBOK can be applied. They possess a number of tools and techniques and offer a sequence of processes or steps to follow. For the purposes of this research, they are referred to as "traditional" methodologies.

The traditional PMM emphasizes to some extent an *a priori* action rather than continuously managing a problem during the execution phase. Roughly speaking, within a "Project Management Process Group" (PMI 2013, p.61), planning contains twenty-four elements while executing only eight and controlling eleven. Numbers cannot be treated here as an absolute indicator of significance but the reader should be aware of these proportions.

In comparison, dynamic methods seem to focus more on direct management of the lack of accuracy or on applying "avoidance" strategies. Techniques may become available which try to manage an "agile environment of frequent change" (Chin 2004, p.62). This, of course, does not promote an estimation bias but in this case an adaptation and flexibility may be more welcome than further investments into improving accuracy. Flexibility may indicate avoidance of the situation causing bias, or direct management of the identified lack of accuracy. Within this research these approaches are referred to as being "dynamic".

2.4.1 A traditional approach to the planning sequence

The estimation process is related to planning. It is rather "multidimensional" work since the "estimating process develops a prediction of how many resources the project will use, how much the project will cost and how long it will take" (PMI 2011, p.34). These estimated elements remain related. A traditional approach to the planning sequence may be considered as an example of improving estimation practice which, among other methods, makes use of three steps, described below.

The first step refers to the broadly understood project deliverables or project phases. Depicted in Figure 6 is a work breakdown structure (WBS) which could be used to organize and define "the total scope of the project" (PMI 2008a, p.116). The estimation process would be supported here by a list of deliverables, each one being assigned requirements, features and functions (PMI 2013, p.555).

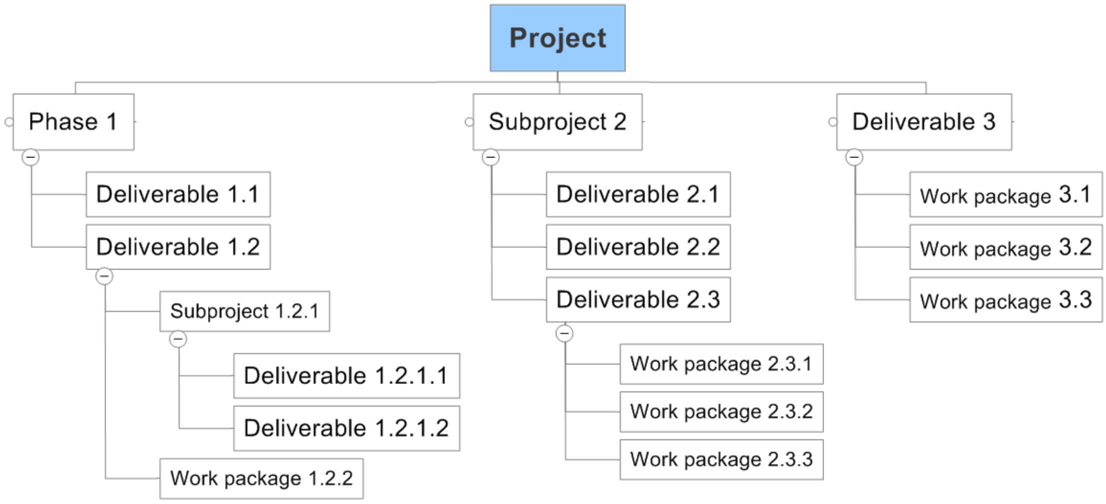

Figure 6 Hierarchized list of deliverables and work packages presented in WBS

The WBS contains work packages which describe the lists of activities. Thus, the "confidence level of estimates is directly related to the activity definition and available information" (PMI 2011, p.12). It is also possible to include a list of exclusions (PMI 2013, p.123) which define what the project does not deliver. It may limit future changes to estimates.

To remain critical, it should be indicated that this method may fail. Often projects at the beginning of their life cycles have a limited description of scope, resulting in a "reduced accuracy of estimate" (PMI 2011, p.12). Therefore, is it possible in all contextual situations to achieve a detailed WBS? For example, within the context of an IT project would it be possible to define from the outset a detailed list of all future software modifications?

The second step of planning is related to sequencing activities (PMI 2013, p.143). This planning practice may influence the accuracy of estimates, as in the case of when a set of deliverables needs to be completed earlier. Thus, failing to assure the correct sequence of activities may limit the accuracy of estimates in the next phase of the project.

In this minimalistic approach to the planning sequence, the last stage would be scheduling. Figure 7 depicts the dependency between scope, cost and schedule. Scheduling makes use of resource levelling where “resource has been assigned to two or more activities during the same time period” (PMI 2013, p.179).

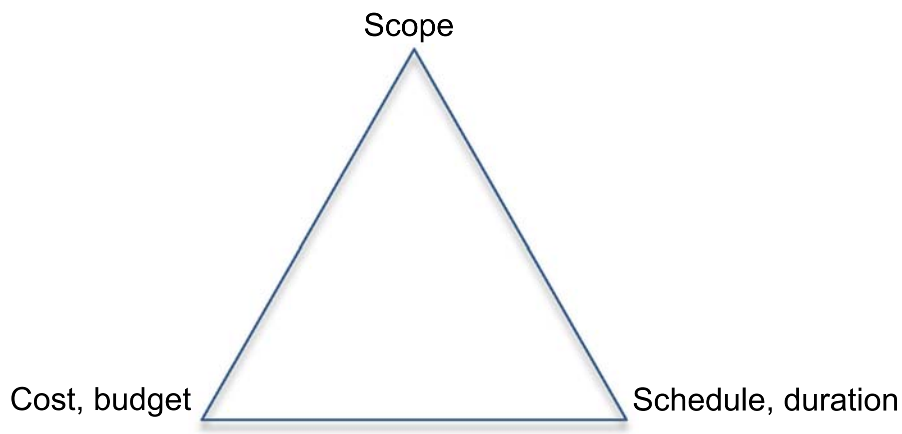

Figure 7 Iron triangle (Morris 2013, p.11) constraining flexibility to accept change

As presented in Figure 7, the “iron triangle” suggests that if the contextual situation constrains all three of the iron triangle’s dimensions then the project may become “unbalanced” and thus “estimated” for failure. Here, the situation may be problematic since “only about 5% of project managers routinely resource-level their plans” (Leach 2000, p.118). It should be considered as a warning sign. When moving to a project portfolio, planning frequency may be even lower – “biannually for some companies, quarterly for others” (Seider 2006, p.47). In short, there are many reasons why the traditional approach to planning may fail to bring satisfactory estimates.

2.4.2 KM in relation to accuracy of estimates – the third objective

The third objective is aimed at further investigating the interactions between an increase in knowledge and the accuracy of estimates. The question is – is this increase always beneficial? Generally speaking, the literature focuses on the positive effect of an increase in knowledge levels, particularly tacit rather than explicit knowledge. The "side effects" of this increase constitute a minor part of this discussion.

KM seems to be one of the key and complex factors in PM. For example, it influences success in RM. It is noticeable that "a typical classification of risks is based on the level of knowledge about the possibility to foresee the risk (known or unknown)" (Petit and Hobbs 2010, p.47). The quality of use of KM is not unconditional. It is possible to have a team which could be "characterised through shared values and a common commitment that create a sense of belonging, trust, and openness" (Coakes and Clarke 2006, p.264). Unfortunately, it is also possible to imagine teams where for some reason knowledge could be kept hidden. KM also seems to be conditioned by the proper use of change management since it "is inherent in the concept of learning" (Knowles et al 1998, p.12). Finally, from the perspective of accuracy of estimates, the question is what quality and type of "historical information and lessons learned information are transferred to the lessons learned knowledge base for use by future projects or phases" (PMI 2008a, p.102)?

Hartmann and Dorée (2015) indicate that, for more than a decade, learning from projects has been investigated. However "progress in improving the learning from projects" (p.341) is slight. Learning from projects happens infrequently and often fails (Atkinson et al 2006; Keegan and Turner 2001; Kerzner 2000, 2009; Klakegg et al 2010; Milton 2010; Williams 2008; Wysocki 2009). Hartmann and Dorée (2015) recognize the influence of learning within the context of current and previous projects. To them, learning is a contextually emerged practice. In their paper they focus on techniques of improving the learning process and in one of the cases, dedicated to a construction organization, they recognize the estimation process. However, development of the learning process is considered here only as an opportunity and as a desirable direction. For example, the risk of being “over-knowledgeable” or the “value of not knowing” is neither discussed nor analysed.

Duffield and Whitty (2015), while investigating organizational learning and the lessons learned process, developed a conceptual model but still focused only on KM benefits and not KM-related threats. They confirmed that, regardless of the existence of a wide range of supporting learning-process models, organizations still fail to learn from projects. The human element was mentioned as being among the most crucial for success. Potentially, it defines a starting point for further investigation of the learning process, knowledge and experience and their influence on the accuracy of estimates.

Terzieva (2014) focuses more on the methods of transferring knowledge and the role of shared and stored experience, rather than recognizing experience as an element shaping human behaviour, and thereby affecting the accuracy of estimates. He (Terzieva 2014, p.1087) asks many questions related to KM but does not investigate any potential “side effects”. Koskinen (2012) acknowledges the dynamic nature of the learning process, the role of context and the importance of cumulative experience. Regardless of his interesting focus on a process perspective, he, too, steers clear of an analysis of threats related to the development of knowledge and experience.

Wells (2012) shows that tacit knowledge tends to dominate in PM. In her view, practices offered by PMMs partially fail. She says that a “large proportion of practitioners (47.9%) disagreed that PMMs fulfilled their expectations for effective project management” (Wells 2012, p.57). Intuitive steering and tacit knowledge “cannot be captured by any methodology because it is highly people- and context-driven” (Wells 2012, p.57). Her view on the value of tacit knowledge in the IT sector seems to be confirmed by Gemino et al (2015). However, despite being project-context aware, Wells (2012) did not recognize any problems related to tacit knowledge in itself. She also narrowed down, contextually, any investigation to the IT sector and did not consider, universally, the wider contextual perspective. For example, Yang et al (2012) to some extent tried to discuss the relationship between knowledge and project context but not from a perspective of the accuracy of estimates but rather from a perspective of a generally defined project success.

Papers which consider both sides of the KM “coin” tend to be found amongst the older literature. To illustrate this: Schultze and Stabell (2004) focus more on tacit knowledge and directly raise the issue of “the value of knowing and not knowing” (p.550). Could this duality be a heresy? This problem is also visible to others (Leonard-Barton 1992; Levinthal and March 1993) but not particularly present in the most recent papers, especially if investigated from the perspective of the accuracy of estimates.

Most of the literature reviewed takes a similar approach. Authors prefer not to debate the potentially negative effects, impacting on the accuracy of estimates, which may be related to an increase in knowledge. Also, there is a visible scarcity of contextually unconstrained discussions. The majority of papers prefer to consider contextually “narrowed” – and thus chosen – companies, projects, or selected business-sector cases. In addition, major PMMs neither consider nor discuss the increase in knowledge as a process which, under some contextual circumstances, could pose a threat to an increase in the accuracy of estimates. Thus, the question remains – could an increase in knowledge also bring threats alongside the opportunities?

2.4.3 Risk management

Risks and uncertainties

From the perspective of accuracy of estimates, RM may “decrease the probability and impact of negative events in the project” (PMI 2008a, p.273). At the same time, project context may or may not allow RM to have access to the historical data of similar projects (PMI 2008a, p.287). Through this, it may define the “border” between usable RM and uncertainties. In a real life scenario, uncertainties are “treated similarly to project risks by practitioners” (Lechler et al 2012, p.59). Unfortunately, uncertainties tend to be rather less manageable than risks. As depicted in Table 1, Cleden (2009) used so-called unknown unknowns to define uncertainties. Only known unknowns could represent manageable risks.

Knowledge (known knowns)	Risks (known unknowns)
Untapped knowledge (unknown knowns)	Uncertainties (unknown unknowns)

Table 1 Plain "four quadrants model" (Cleden 2009, p.13)

Some writers define this "border" between risks and uncertainties by a "lack of information required to quantify/qualify risk estimates" (Kutsch and Hall 2009, p.73). Kendrick (2009) confirms this problematic situation by concluding that "risk management requires knowledge of the root causes that lead to project problems" (Kendrick 2009, p.146), and therefore "it is important to realize that some uncertainty will remain no matter how thoroughly the project is planned" (Cleden 2009, p.23). In the traditional view and from a perspective of the accuracy of estimates, RM should not be abandoned since "the accuracy of activity duration estimates can be improved by considering estimation uncertainty and risk" (PMI 2008a, p.150).

Critical view

While being critical of the traditional way of thinking, it is possible to identify the more innovative management of uncertainties as an opportunity. It still affects the accuracy of estimates but the perception of the "problem" may be different. Potentially, traditional PM "does not offer a conceptual basis for understanding the relationship between uncertainty and opportunity" (Lechler et al 2012, p.59). If one paid attention to uncertainty then "opportunities should be created or discovered leading to an increased value proposition for the project and enterprise" (Lechler et al 2012, p.67). From the perspective of this thesis, it calls for more flexibility within the project scope. If a project context allowed this flexibility then why not use uncertainties to change a project baseline and gain new opportunities?

RM, even if helpful in the management of the problem of inaccurate estimates, may go wrong for many reasons. There are teams which recognize "project time constraints as one of the major reasons for not using risk analysis" (Akintoye and MacLeod 1997, p.37). It may also be possible that "the analyst's cultural bias prevents him identifying the risk simply because he either cannot see it or considers it inherently acceptable" (Frosdick 1997, p.169).

Moreover, the “techniques of risk estimation are largely quantitatively based and make claims to scientific objectivity, which are undermined on several fronts” (Frosdick 1997, p.176). Do the majority of companies have a history of many similar projects that assure a statistically significant sample for risk analysis? It is known that “the larger the sample the narrower the band (called confidence interval)” (de Vaus 2001, p.189). If a PMM requires a team member to deliver quantitative analysis while the context of the project prohibits access to the historical data, then the accuracy of the estimate may decrease. Not surprisingly, in a quantitative approach, “in the absence of adequate data, the assignment of probabilities is a subjective process dependent on the assigner’s own bias” (Frosdick 1997, p.176).

The researcher originates from an “engineering paradigm” (Frosdick 1997, p.170) but over the years his trust in solely quantitatively-based estimates has decreased. However, to remain impartial, it would be difficult to share without question the standpoint which claims that “the benefits of project risk management are not quantifiable in advance” (Kutsch and Hall 2009, p.75). It could become another excuse to abandon RM practices. Even if Kutsch and Hall (2009) had referred to IT projects, someone could still quantify the selected risks. Potentially, and to support RM, “the obvious, pragmatic approach is to sort the risks in groups based on common features” (Krane et al 2010, p.83). Krane et al (2010) divided risks into long- and short-term, strategic and operational ones.

Risks are “always in the future” (PMI 2008a, p.275). They may result in biased estimates. The above indicates that, depending on project context, there are situations where the more traditional methods of dealing with inaccurate estimates may fail or succeed.

2.4.4 Buffer management – the fourth objective

The fourth objective verifies whether the BM concept (PMI 2008a, p.162), present within CCM, can be broadened and improved. Generally, the literature which considers CCM accepts the phenomenon of inflated estimates and safety margins. However, if besides overestimation, underestimation is recognized, should that imply the necessity to reanalyse how to define project buffers? Especially to effectively secure project deadlines and milestones?

Assumptions

According to Goldratt (1997), "time estimates are based on a pessimistic experience" (p. 50). He supported this statement by reference to:

1. The "global cut" – supervisors are keen to achieve savings and therefore subordinates overestimate to secure themselves against anticipated "cuts".
2. The number of management levels, which could be understood as a measure of complexity of functional structure.

He promoted his method among practitioners and proposed to solve the problem of a lack of satisfactorily accurate estimates by applying buffers. He used the uncertainty in estimated duration "to size the project buffer" (Leach 2000, p.118). As depicted in Figure 8, there are presumably inflated buffers in the schedule – overestimations.

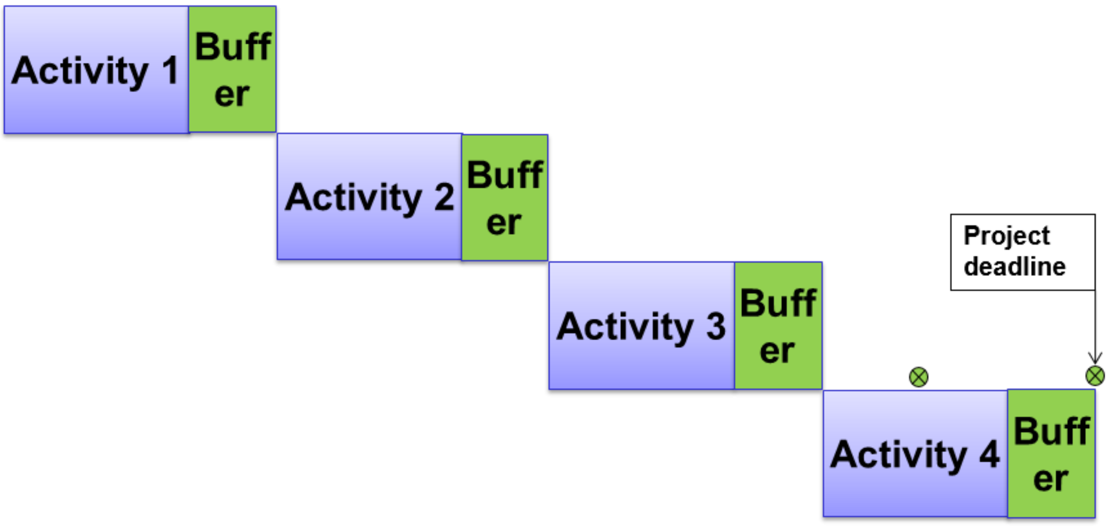

Figure 8 Schedule with activities characterized by inflated buffers

Furthermore, as presented in Figure 9, such buffers could be summarized and located at the end of the paths to secure a project deadline.

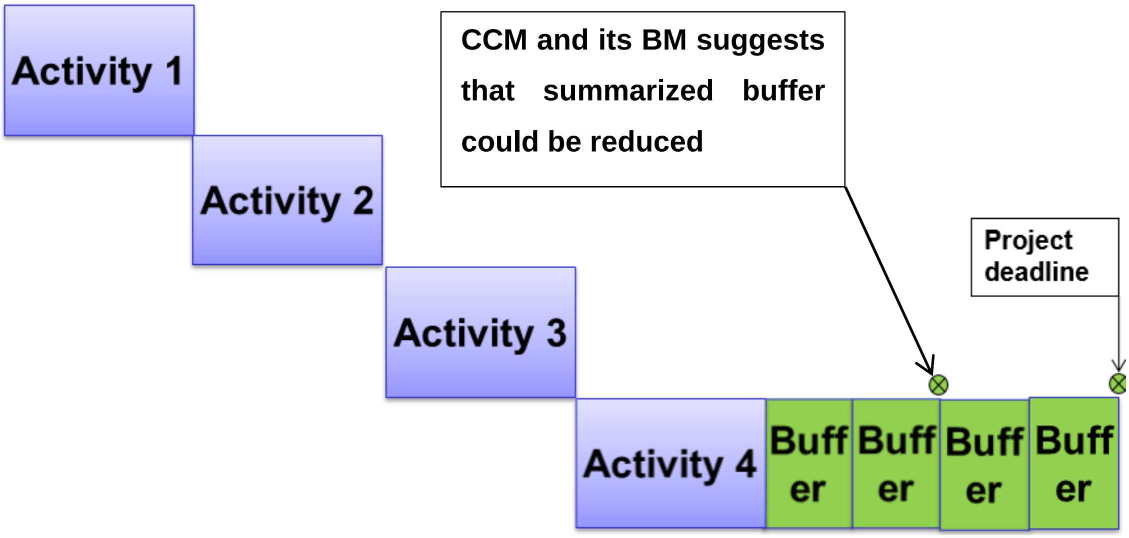

Figure 9 Summarized buffers to secure deadline

To simplify, without entering into a discussion of different types of buffers, it could be said that CCM "rests" on two major "pillars" (PMI 2013, p.178):

1. Schedule work to resource "bottleneck" – apply the principles of the theory of constraints (TOC).
2. Identify inflated buffers and summarize them to protect the delivery date.

Within CCM, an assumption could be found that summarized buffers could be reduced to allow the release of resources to other projects at an earlier stage. This assumption may promise savings. While being critical, it may also be one of the factors of CCM and its BM that could gain the interest of practitioners. However, the same simplicity may open the door to formal academic criticism. Trietsch (2005b) claims that "Goldratt's teachings are indeed too simplistic" (p.28).

Critical view

The perception of experience may vary and sensed project changes may affect estimates, priorities or scope (Kerzner 2000, p.385). Some experience may appear "through the intellectual process of thinking and understanding" (Coghlan and Brannick 2005, p.33). However, if the "fundamental response to change is not logical, but emotional" (DeMarco and Lister 1999, p.197) then it is also possible that they “occur in feelings and emotions” (Coghlan and Brannick 2005, p.34). It seems that the potential basis for the Goldratt (1997) assumption of pessimistic experience could exist. However, what if his teaching oversimplifies the debate over triggers that condition the appearance of this phenomenon?

Clarke (2010) argues that reflection depends on reaction to feelings and emotions. If present, emotional competences could help “project managers to become reflective practitioners” (Clarke 2010, p.5). On the other hand, it is known that “people who lack adaptability are ruled by fear, anxiety, and a deep personal discomfort” (Goleman 1998, p.98). Potentially, “project managers with high emotional intelligence should be better equipped to solve the new challenges and problems that each new project brings” (Clarke 2010, p.5). Such a discussion was ignored by Goldratt (1997).

There has been some brave talk about the “so-called Goldratt innovations” (Trietsch 2005b, p.27), and that his CCM “mainly involves packaging old ideas” which “is certainly a clever packaging” (Trietsch 2005b, p.28). For example, there are writers who assume that TOC was “developed primarily by Dr Eliyahu M.Goldratt” (Mabin and Balderstone 2003, p.569). Nonetheless, they also point out that TOC is mainly applied in the manufacturing sector, not in PM where it may result in more frequent re-scheduling activities. It is known that no earlier than “in his third novel Eli Goldratt demonstrates the application of his Theory of Constraints to Project Management” (Rand 1998, p.181). Even if Mabin and Balderstone (2003) or Sider (2006, p.43) stress that TOC was developed mainly by Goldratt, the “lack of criticism associated with the use of the TOC methods” (Mabin and Balderstone 2003, p.590) is apparent. Is it, for example, feasible to monitor the shifting “bottleneck” in a situation characterized by frequent change?

An article under the title “Why a critical path by any other name would smell less sweet? Towards a Holistic Approach to PERT/CPM” (Trietsch 2005b, p.27) indicates that CCM may be nothing new. But according to PMMs, the choice between critical path method (CPM) and CCM persists – “Some of better known scheduling methods include critical path method (CPM) and critical chain method (CCM).” (PMI 2013, p.142). Use of BM is indicated among the differences (PMI 2013, p.178). Trietsch (2005b) claims that CPM used in conjunction with PERT results in CCM. He says that “PERT/CPM had been an instance of Goldratt’s ‘Theory of Constraints’ (TOC) before Goldratt had articulated it” (Trietsch 2005b, p.27). Unfortunately, it may be that the PERT method is, in itself, not sophisticated enough to calculate and manage estimation bias. To calculate expected estimated value it uses the weighted average (PMI 2013, p.170). Thus, PERT “uses a probabilistic approach” (Burke 2003, p.295) but Rand (1998) concludes that when thinking of PERT “it is well documented that the approach is based on faulty statistical foundations” (p.181).

Trietsch (2005b) remains critical of CCM and its BM: “papers that seek to study the good and the bad together – exactly what we need! – are rare” (p.28). This standpoint is similar to one adopted by Herroelen and Leus (2001). Trietsch (2005b) says that Goldratt was “not always correct” (p.28). Potentially, correctness could be clarified by considering specific contextual situations. It is noteworthy that in his paper Trietsch (2005b) does not discuss contextual factors which could condition the use of CCM.

This struggle to mathematically solve the problem of BM continues and is clearly visible in the literature. In critical analysis of CCM pitfalls, Herroelen and Leus (2001) could not accept what is proposed in the CCM approach to BM. However, even if they agree that relying on “right-skewed probability distribution for the duration” (Herroelen and Leus 2001, p.562) may be inappropriate, within BM analysis they do not address potential underestimation directly. Later, and similarly to Herroelen and Leus (2001), Yang and Fu (2014) consider buffer-sizing methods: cut-and-paste and root-square-error methods. Again, Yang and Fu (2014) do not attempt to consider underestimation directly. In addition, they narrow their discussion of buffers to automobile research and development alone. An improved root-square-error method was only theoretically verified in software simulation by Xue-mei et al (2010) and not communicated with PM practitioners. Here, open discussion of the two directions of buffer volatility is abandoned and narrowed to the known but infrequently used methods, and confined to software development projects. Finally, the paper of Tukel et al (2006, p.408) certainly brings new models to CCM-related BM. However, they verify them only in a simulation study and again do not communicate with the PM community.

Zheng et al (2014) develop a complex model, based on CCM, to handle constraints but do not attempt to further investigate the BM problem. In what may be considered contributory to the scientific interest of the research, Bevilacqua et al (2009) recognize, within CCM, underestimation alongside overestimation. Nonetheless, they do not open the topic contextually due to the limitations of the case study approach used. Finally, even theoretically heavy CCM and BM models, as offered by Wei-xin et al (2014), seem to abandon discussion with the PM community and somehow invest time into a deliverable which may not necessarily be picked up by practitioners due to its complexity.

Trietsch (2005a) attempts to improve the BM model by statistically using historical data to correct bias. He highlights both positive and negative bias and recognizes the role of project context. Unfortunately, his single-point-estimate model does not consider the volatility of past projects' various contextual situations and, thus, may over-rely on collected historical data. The size of the project buffer is context-sensitive and not only dependent on business sector, as Tukel et al (2006) presented – the "size of a buffer in a high uncertainty environment, such as new product development, is more crucial than determining it in construction" (p.402). Yet, the size of a project buffer may change from one project to another – even within the same company and business sector. As an illustration, a BM method proposed by Trietsch (2005a) could not be used for "non-routine projects because of lack of statistical data" (Long and Ohsato 2008, p.689).

In most cases, papers discussing CCM and presenting BM concepts can be characterized not by the word "update" but rather by the word "exchange". They prefer to verify new concepts locally on the basis of chosen cases, business sectors and simulation software rather than promulgate them widely within the PM community, considering the influence of the CCM brand. Papers discussing project optimism and pessimism, especially from the perspective of a single business sector, are present. Unfortunately, papers which discuss the duality of underestimation and overestimation within the CCM and BM context are rare.

Regardless of whether CCM users follow the simple assumption of inflated buffers without reflecting on the actual scientific complexity of this topic, the problem is still that CCM is a PM-market heavyweight concept and Goldratt receives considerable attention from PM practitioners. It all requires careful treatment of the method. The researcher is of the opinion that business knowledge should serve its practical use and therefore CCM weaknesses should be considered as an opportunity to evolve and to “focus on an efficient method for determining project buffer size in particular situations” (Long and Ohsato 2008, p.697). It seems to be necessary to adjust the research strategy in order to assure verification of the perception of CCM and BM within the PM community, and not just within selected cases, chosen companies, specific business sectors or software simulations. Goldratt assumed that “typically project managers try to protect the performance of each step of the project by adding safety at each step” (Tukel et al 2006, p.402). What if the PM community is of the opinion that it is not always that typical? Should it not restart the debate about BM?

2.4.5 Improvement of estimates or avoidance of the problem – the fifth objective

The fifth objective is an attempt to establish a guideline as to whether a PM practitioner should focus on techniques improving accuracy of estimates or rather on techniques managing an expected lack of such accuracy. This management may involve the use of the BM already discussed or a more avoidance-oriented strategy – agile. The latter serves the nature of “emergent projects” (Binder et al 2014, p.184) well and is recognized as a description of a dynamic, adaptable “solution”. It tends to focus on how to avoid the problem of a lack of accuracy of estimates. Might it be possible that the present perception of agile influences its efficient use?

Firstly, many practitioners may consider agile techniques as representing more advanced PM. It may imply unwarranted criticism of “older” methods by simply calling them traditional – that is to say, not the most modern. PM organizations tend to reinforce the separation of traditional and agile approaches (Morris 2013). For example, in addition to the “Project Management Professional” (PMI 2013, p.2) certification programme, the “PMI Agile Certified Practitioner” (PMI 2013, p.2) is available. From the perspective of a “globally recognized standard” (PMI 2013, p.1) and to confirm either the more traditional or the more agile competences, it becomes a question of the type of certification exam.

Some academics recognize this problem and, for example, Clarke (2010), to some extent, “provides guidance on how to apply both approaches together (traditional and agile)” (p.11). As an illustration, it may be possible to imagine a fixed milestone schedule with activities accomplished through rolling-wave planning – the fixed planning iterations “usually 2-4 weeks in length” (PMI 2013, p.527). Unfortunately, Clarke’s (2010) investigation is not focused on managing inaccurate estimates.

Furthermore, within detailed analysis and work on the “hybrid model”, Binder et al (2014, p.187) identify the similarity between traditional re-estimating and the agile progressive estimating approach. Nonetheless, they do not go beyond the listing of similarities or differences between waterfall (traditional) and agile models. Advice as to whether one should focus on the reduction of estimation bias or on avoidance of the problem was not given.

Secondly, the perception is present that agile is associated with the IT sector. Agile used to be related to “agile software development” (PMI 2013, p.74). This view may be strengthened by some papers such as one, for example, presented by Ibrahim and Darwish (2015). There they search for the use of agile techniques by non-agile companies but limit themselves to software development organizations. Similarly, Špundak (2014) tries to discuss hybrid approaches but although the discussion is to some extent contextually open, it is again on the basis of software development projects. While investigating the literature on agile requirements engineering, Inayat et al (2015) narrowed the problem down to software development and, in another example, it was narrowed further to web development projects (Torrecilla-Salinas et al 2015). Even techniques directly addressing the accuracy of estimates and the estimation process (as, for example, planning poker) are considered mainly from a software development perspective (Mahnic and Hovelja 2012). This trait can be found again and again in the associated literature.

In the opinion of the researcher, this practice may defocus discussion from project context and inappropriately push agile towards one business sector. It may define an unnecessarily narrow business niche where agile techniques facilitate the problem of inaccurate estimates, which may be misleading.

Fortunately, an ongoing academic discussion also proves that a contextual and more universal perception is possible. Although still constrained to software development projects, the “bridge” to more contextual thinking was presented by Kruchten (2013). He indicates the conditioning of the use of agile contextual elements such as project size, large systems without architectural focus and not driven by customer demand, lack of support from stakeholders, a novice team, and constraints on the quality attributes (Kruchten 2013, p.352). Earlier, Chin (2004) explained in a similar manner that often there is no sense in practising agile methods “across multiple corporate cultures” (p.18). Chin (2004) contextually argues that the use of agile should be arranged under “a single organizational umbrella” (p.17) with “fewer organizational stakeholders” (p.17), observing that “frequent change” (Chin 2004, p.62) may also be placed among the conditioning of contextual elements.

What is more, Conforto et al (2014) help to “open the door” to making use of agile in industries other than software development. They list independent agile organizational enablers as project manager experience, team size or the process formalization level (Conforto et al 2014, p.30). This all seems to be moving in a promising direction. Unfortunately, at least one element is missing. Neither Kruchten (2013) nor Chin (2004) nor Conforto et al (2014) analyse agile from the perspective of selecting an approach aimed at managing inaccurate estimates. Nevertheless, their work is still a valuable contribution to a more contextually open consideration of agile.

Finally, it is worth recognizing the paper of Jahr (2014), where he indirectly addresses the improvement of accuracy of estimates within his unique hybrid approach. Even if he still narrows the debate to software development – and improvement of accuracy seems to be more of a by-product than anything – this paper proves that discussion of traditional, agile and various hybrid approaches with consideration for the accuracy of estimates is possible.

In summary, a strong market association of agile with IT-related projects seems to pull the focus away from project context and put agile forward as an example of modern software development. Fortunately, the available academic papers cover this issue to some extent but practitioners are not always aware of this. While remaining critical, and bearing in mind the fifth objective, the scarcity of papers contextually considering the selection of various approaches from a perspective of focusing on improvement of accuracy of estimates is apparent.

2.5 Conclusion

2.5.1 Literature review in reference to project objectives

The conducted analysis of the existing literature necessitates a few reflections. It appears that the papers analysed have some gaps or inefficiencies which could be addressed by the fulfilment of this project's objectives. The academic documents analysed often associate the problem of accuracy of estimates to a particular business sector or they provide models that are only locally valid and niche-oriented tools. Thus, flexibility within discussion and contextually open generalization is limited. Nevertheless, undue generalization of findings is sometimes evident. A macro-project perspective which tags whole projects as being overestimated or underestimated is visibly dominant. PMMs tend to avoid the contextual conditioning of specific tools and techniques. They prefer to offer whole, designed and branded toolsets. Ironically, PMMs recognize the leading role of context and consider its range to be almost unlimited (PMI 2013, p.29), but do not teach how to make practical use of it.

The first and second objectives focus on the contextual perspective and the project's context-aware framework. Within this thesis, it is possible to orient discussion more toward the micro-activity level of analysis and there observe both underestimated and overestimated activities. Furthermore, it may be possible to discuss the feasibility of the framework being adaptable to various business sectors and projects, even with a limited contextual repetitiveness being observed from one project to another. Project context awareness seems to be a better choice than "deciding" upon the "level of accuracy" (PMI 2013, p.199).

The third objective sets a clear ambition and complements the academic discussion. Will an increase in knowledge also bring difficulties? KM-related papers show that it often fails in PM, regardless of the years of scientific investigation into the topic. In most of the papers, authors avoid the discussion of any negative “side effects”, brought about by an increase in knowledge and experience, on accuracy of estimates. It is also the case that KM papers prefer to constrain the debate to a specific business niche. They do this even while admitting that learning is a contextually (that is to say, from a wider perspective) driven practice. Furthermore, major PMMs neither consider nor discuss an increase in knowledge as a process which, under some contextual circumstances, could pose a threat to an increase in accuracy of estimation. The “value of knowing” and “not knowing” have in the past had their place in academic discussion, albeit not primarily focused on the accuracy of estimates.

The topic of BM seems to be widespread in the literature. However, it could be characterized by at least two common patterns. Firstly, papers discuss various BM models. Some of them are very sophisticated, some are well-known – as, for example, the cut-and-paste and root-square-error methods. The problem here is that the effects achieved are often constrained by the research strategy adopted, e.g. making use of simulation software or analysing one particular case. This effectively confines generalization and avoids wider contextual awareness. The communication of such findings within the PM community is also limited. The second pattern considers BM purely as an element of the CCM method. Here, papers directly “attack” CCM for many reasons (not only related to BM) or they recognize its value without much critical reflection of its predominantly overestimation-oriented perspective. Here, a scarcity of papers analysing the relationship between BM and project context, particularly in relation to both overestimation and underestimation, is evident.

Thus, for these reasons the fourth objective remains focused on CCM and the BM concept. The phenomenon of inflated estimates may not be as common as CCM suggests, especially when viewed from a micro-activity rather than a macro-project perspective. If, besides overestimation, underestimation is present, might it imply the necessity to reconsider how to secure a project’s milestones? Awareness of the various context-dependent arguments, and the existence of PM practitioners who share understanding of CCM and its BM paradigm, must be present.

In a similar way to the BM concept, dynamic approaches related to agility do not insist on *a priori* as the best possible project-scope planning. Instead, agile tends to avoid the problem of inaccurate estimates by using "adaptive Life Cycles" (PMI 2013, p.46) and works with a sequence of scope chunks to, among other objectives, incrementally decrease the problem of inaccurate estimates. There is some "conflict" visible between users of traditional PMMs and agile. Some papers consider agile to be more modern and this is now reinforced by recently developed certification programmes. Of course, there are also papers available which even try to hybridize both approaches – they, however, do not constitute the majority of publications. Another problem that pulls focus away from contextual discussion is the strong association of agile with IT software development, with relatively few papers studying wider areas of agile application. Regardless, the scarcity of papers contextually analysing the selection of various (traditional, agile or hybrid) approaches with a focus placed on the improvement of the accuracy of estimates is clear.

Having said that, the fifth objective is an attempt to support a PM practitioner in considering whether he or she should focus on techniques improving accuracy of estimates or, instead, on techniques managing an expected lack of accuracy, along with a continuing contextual awareness. It considers both the estimate's volatility management through the use of BM and a more avoidance-oriented approach – agile.

2.5.2 Implications for research strategy

In the next two chapters the philosophical standpoint and research methodology is debated. Literature analysis provides reflections which may, to some extent, influence research design.

Different papers depict various perceptions of what project context actually is. PMI (2013) considers it to be described by, though not limited to, a list of environmental factors but some tend to exclude chosen factors and consider them individually. For example, while thinking of uncertainty sources, Lechler et al (2012), alongside "contextual turbulences" (p.67), identifies, in his view, exemplary uncertainties: stakeholders, technology, organizational changes, project complexity and absence of best PM practices. Then this list becomes separated from turbulent contextual factors. Therefore, to avoid unnecessary confusion within this research, context is most often aligned closely to the definition of enterprise environmental factors (PMI 2013, p.29). This list is "not limited" (PMI 2013, p.29) and may be extended.

This reflection may influence discussion of the selection of research strategy. One might ask the question: would it be practical to propose a survey with a great number of questions considering a predefined list of contextual factors? Researchers should be aware that "most sample surveys attract a certain amount of non-response" (Bryman and Bell 2007, p.196). Such complexity could violate the correctness of the surveying process. Among other things, it may indicate that more explorative approaches should be preferred.

Lastly, studying the literature demonstrates a scarcity of papers proposing BM models, frameworks and estimating methods which could be characterized as ones that are developed with a socially agreed understanding with the PM community in mind. It seems that it is possible to offer some new business models but it is difficult to be efficient enough to maintain constant verification against the view of PM practitioners. This reflection may be even more important because the research project addresses, to some extent, PM "gurus" and CCM and BM methods. Thus, the research strategy, beside the inductive and explorative process, should assure constant verification of findings with the PM community. This is also supported by the researcher's engagement in publicity as depicted in Figure 4.

3 Methodology – qualitative perspective, philosophy and interpretivism-based paradigm

3.1 Introduction

A paradigm influences perception of an outside world and affects how someone gets to know about it. Lack of understanding of one's own paradigm may effectively limit dialogue between practitioners and researchers. Incommensurability of paradigms "mean that scientists cannot have a rational dialogue across the boundaries between two or more paradigms" (Johnson and Duberley 2000, p.74). It seems to be even more important since the PM world is puzzled by PMM strongholds and different points of view. Additionally, a paradigm shared by a researcher should harmonize with the research design and with the perception of deliverables provided by a research project.

Having said that, a paradigm should be well explained and understood. This process may be supported by discussing questions related to ontological and epistemological standpoints. The researcher does not expect the reader to shift his or her paradigm. Yet, changing a paradigm represents "a fundamental shift in the way scientists think" (Gaarder 2007, p.457). Nonetheless, awareness of potential differences between reader and researcher is vital. It may help to better understand the perception of a selected research approach and support the understanding of the main deliverables of this work.

3.2 Characteristics and history of the qualitative approach

The qualitative approach is not one approach but actually a set of research methods, such as a case study, observation, ethnomethodology, phenomenology, clinical research, biographical methods or grounded theory. In some situations these approaches can interlock with each other. For example, Cho and Lee (2014, p.15) provide a list of similarities and differences between purely qualitative content analysis and an approach making use of inductively focused strategies. The history of the development of qualitative research methods allows their present broad use. Different applications and features of the methods were described by Denzin and Lincoln (1994).

Strauss and Corbin (1998) indicated that qualitative projects prefer to focus on applied techniques and methods and not on the type of data collected. In other words, qualitative data could also be analysed statistically. Similarly, numerical data could be coded and analysed qualitatively. Additionally, according to Bryman (1998), a qualitative approach discourages the use of any presumed standpoint. In this view, one's mind should remain open and, at the same time, research design should remain flexible too. It does not constrain being knowledgeable of earlier findings or already undertaken research projects. It is more that a need for "discovery" remains central. Not surprisingly, "the phenomenon of interest must be discovered and the researcher must be flexible enough to respond to such discoveries" (Murphy et al 1998, p.6).

Denzin and Lincoln (1998) divide the history of qualitative research into five major stages of development:

1. According to them, the traditional period between 1900 and 1950 was characterized by a positivist paradigm. Findings were expected to remain objective. Objectivity as well as reliability and validity were still measured. The problem was expected to remain "touchable" and observable. What lay beyond this horizon was perceived as something strange.
2. The next modernist phase could be identified from 1950 to 1970. Being characterized by post-positivism it attempted to apply modified statistical approaches to gathered qualitative data. This period was productive in a formulation of a new interpretive approaches. Feminism, phenomenology, and ethnomethodology were defined. The positivism-oriented approach in analysis was still visible.
3. A period between 1970 and 1986 saw a number of blurred genres that could be considered as making particular contributions to this research. Case study and research strategies focused on an inductive reasoning process emerged. In data collection, semi-structured interviewing and open questions were applied to research practice. Constructivism theory came into being as well. It should also be noted that, historically, computer-based analysis found its accepted application at this time too. It became possible to analyse texts and transcripts.

4. The subsequent short period between 1986 and 1990 could be characterized as a representation crisis. This crisis of representation indicated a problem related to the role of a researchers. How to find and identify their role within problems related to applied research methodologies, especially in terms of generalizability and validity. New ways to better analyse each individual context were developed.
5. Finally, starting in 1990 and valid to the present day, a postmodern period preferred to focus on the understanding of social phenomena in a local context, thus resulting in the formulation of locally valid theories. Elements of local values and moral criteria were included. Locally valid theories were exchanged for “grand narratives” (Denzin and Lincoln 1998, p.22). This period is not considered as being particularly evolutionary to the development process of qualitative methods. It was, however, characterized by a few major debates which could provide its further decomposition.

3.3 Ontological assumptions

A description of the researcher’s ontological position could start with an answer to the question “what do you notice and what do you ignore, because it’s less important” (Jankowicz 2005, p.106)? In the view of the researcher, it could be assumed that current major PMMs more or less fail to employ a project context and, ironically, they praise its importance but in practice may be cavalier in its use.

However, there are hundreds (Wells 2012) of methodologies available. Having such a great file of potential approaches, how is it possible to answer the problem raised in the title of this research? Should someone develop an analysis of the majority of methodologies available to advise on their use? Should a project manager start a project with a large guide to discuss what methodology should be applied? Indeed, it could be assumed that an experienced project manager may consider PMMs to be less important than tacit knowledge (Wells 2012, p.57). In this dissertation this ontological perception is shared: PMMs are not the most important, especially when compared to the decisive role of the project context.

Relativism builds on the perception of the endless list of a project's contextual configurations. There may be no single "silver bullet" assuring an improvement in the accuracy of estimates. Each project constructs its own reality. It seems that articulated in the title of this research is a problem that calls for a framework which shares an interesting ontological characteristic. Since realities are constructed then, logically thinking, a framework should be flexibly reconstructed for each individual project case and context.

PMMs may attract attention by their brand names and somehow distract from their contextual fundamentals. Potentially, they may even pull away from an understanding of individually constructed projects' realities. If practitioners were more aware of their own ontological standpoint then, arguably, they could know that a "real reality" differs to a constructed one. Ontological openness toward dynamically constructed realities should be maintained.

Within someone's ontology the world cannot simultaneously consist "of people, or processes, or effectiveness, or guiding principles, or actions, or language communications, or rules and belief systems, or motives and constraints" (Jankowicz 2005, p.106). Therefore, in this research, the world consists mainly of people involved in PM-related processes; people being influenced by various contextual factors. The researcher, having for many years had the opportunity to read widely, understand and follow this or that PMM, has realized that it could be possible to rethink the project start point. To accept relativism and the dynamic construction of an answer. In other words, to individually answer how to improve the accuracy of estimates.

3.4 Epistemological assumptions

Epistemology "provides ways of deciding what counts as knowledge and what doesn't and, related to this, what counts as evidence" (Jankowicz 2005, p.108). An approach based on constructivism, phenomenology and interpretivism does not search for "truth" but rather for accepted and agreed understanding (Jankowicz 2005). The moment of achievement of socially agreed understanding could be observed by an increase in the saturation level and response gained from the PM community.

For example, it may be possible to exploit PMs' own sources of knowledge – the stakeholders. They "may affect, be affected by, or perceive itself to be affected by a decision, activity or outcome of a project" (PMI 2013, p.30). PM stakeholders interact with projects and contextual situations and may offer subjectivist-created reflections. Yet their experiences are contextually individual. Thus, within the PM community, they could become a valuable source of verification of what, in terms of cognitive exploration, counts as knowledge.

Moreover, the question is whether someone should narrow down sources of knowledge to a specific business sector. It may be tempting due to the positivistic perspective of possible local generalization. Here the answer considers both ontological and epistemological standpoints. It is not intended to achieve some "probably true" and "objective" for some selected business-sector deliverable. There are already hundreds of similar PMMs available and more are potentially appearing. This could, again through a positivist prism, further divide PM practitioners in their comparisons. It is enough to remind ourselves of conferences and journals and discussions elaborated between followers of "traditional or more dynamic" approaches in order to steer clear of being trapped in a predominantly positivistic or post-positivistic paradigm. A constructed answer to a contextual situation does not need a label or brand. Neither does it need to be hailed as the chosen one for a particular business sector.

Thus, sources of knowledge – respondents, cases, observations – should assure the creation and applicability of a common framework for business sectors and associations. "Common" indicates the ability to serve multiple, and even sometimes opposing, social realities.

3.5 The assumed role of the researcher

The position of the researcher could be characterized mainly through an inductive process designed for the creation of a framework.
Of course “qualitative work can begin from and return to deductive thinking” (Murphy et al 1998, p.4). Nonetheless, the induction defines the core part of this project. The deductive process probably took place in the years preceding this research, mainly as an element creating confusion and affecting motivation to undertake the study of the topic. The statement that “qualitative research can also be done in a deductive fashion, where prior theories or generalizations are tested on new cases” (Murphy et al 1998, p.2) finds its partial fulfilment only in this research pilot study and related discussion of CCM and its BM.

The role of the researcher, regardless of ontological and epistemological positions, should be characterized by an unbiased standpoint. This is an element which, within the formulation of research design, data collection and analysis, is considered to be a sign of the quality of all subsequent findings. This is even more important since “bias is inherent in all observational and coding schemes” (Murphy et al 1998, p.43). These are exactly the areas where problems must be kept under control. Thus, apart from those formally indicated in Section 1.5.1, assumptions are put aside.

Furthermore, interpretivism remains rather personal and there is the temptation to write this account in the first person. Unfortunately, that could bias an output by *a priori* assumed answers and somewhat limit impartiality. Exploration could become affected by hidden and unrevealed subconscious assumptions.
To mitigate this risk it was decided to represent the researcher’s view in the third person form.

3.6 Conclusion

Constructivism and interpretivism depend on interaction between researcher and respondent. This is an interaction that creates knowledge. Working from a constructivist, phenomenological and interpretivist position leads to one major conclusion: that the induced framework should be able to adapt to the various contextually defined realities.

Positivist and even post-positivist approaches may be unable to fulfil the research goal for two major reasons, even if PM "knowledge is often presented in a positivist, absolute manner" (Morris 2013, p.13). One is that it is not intended to arrive at "objective truth". "Truth is elusive, particularly in the social sciences" (Morris 2013, p.7). Such a goal could ruin further development and potentially expose the framework to destructive criticism. Furthermore, it could become impractical to apply for being too complex. It seems that the researcher's ontological and epistemological standpoint is consistent with the future PM trends where "more interpretive epistemologies are needed" (Morris 2013, p.13).

Jankowicz (2005) states that knowledge creation could be defined by the elements depicted in Table 2.

An assertion that certain beliefs might be plausible
Information relevant to the plausibility of that assertion
Some method for bringing the first two elements together
Some means of convincing other people that the outcome you obtain makes sense

Table 2 Four elements of research (Jankowicz 2005, p.109)

The first two elements, and to a certain degree the fourth, have already been raised. The third element indicates methodological plans to approach the problem and is discussed in the next chapter, dedicated to the research strategy.

4 Methodology – discussion of methods and design of the research

4.1 Introduction

In this chapter, possible approaches to the research design are discussed in terms of their usability in relation to the research goal and compatibility with the research project context. Attention is thus paid to the notion that "selection of method should be driven by the kind of research questions" (Robson 2002, p.385). Reflections from the pilot study are provided to support both discussion of the assumptions behind CCM, and development of the research strategy. The researcher also describes the data collection and analysis processes. Further, it is explained that the purpose of making use of an inductive toolset is to exercise its potential to induce a new framework and not a new theory.

4.2 Potential research strategies

This research is anti-positivist in nature as it does not search "for truths 'out there'" (Jankowicz 2005, p.110) in an objectivist way. In order to achieve an open framework the researcher does not constrain himself to one business sector. In having a wide range of examples to analyse, it may become impractical to use an objectivist approach. Investigating a long list of contextual factors may pose the risk of inefficient use of sampling. In a positivistic approach, to avoid this risk, it might be necessary to narrow research to a specific business niche or sector, which could breach the requirement for framework openness and adaptability. In addition, the framework is intended to help find a consensus between different PMMs and thus should not be associated with any specific business sector.

PM-related epistemology cannot accept that "truth exists independently of the people who seek it" (Jankowicz 2005, p.110). Elements of human nature, such as beliefs, emotions and culture, count as evidence as well. In general, what this suggests is that an explorative approach may be preferred. That said, the following is a discussion regarding the plausibility of making use of potential research designs while respecting ontological and epistemological perspectives as well as the research project context:

1. Longitudinal – this approach is founded in repetitiveness of observation conducted and organized along a time axis. It could, for example, be applied to future framework testing. However, it may not be entirely feasible here because, as described in Section 1.6, the researcher works mainly on the basis of short contracts. The use of a longitudinal research design could be discussed further if the research project was carried out in a single organization. Notwithstanding that, it can be imagined that some observations, if long enough, exhibit a longitudinal characteristic and could, for example, be more frequently used to verify a socially agreed understanding.
2. Ethnographic – this approach would involve the researcher being embedded in the PM work of the enterprise(s) under investigation. In this method, "people are studied for a long period of time in their own natural environment" (Robson 2002, p.186). This approach is interesting and from a social analysis perspective is very tempting but, unfortunately, it is not sufficient for the purpose of this research as it would unnecessarily narrow the scope of investigation and limit the potential applicability of the framework. It also has a long-term nature, as in a longitudinal case, and is therefore subject to similar constraints in the particular context of this research project.
3. Experimental – this is primarily applicable to hypothesis testing. It is a positivist "hypothetico-deductive method" (Jankowicz 2005, p.112). Thanks to the objective of inducing a new framework, the planned work has an interpretivist and constructivist orientation. Furthermore, in an experimental approach, the establishment of a control group and specific treatment would be necessary to observe changes achieved through experiments (de Vaus 2001, p.48). This may not be possible here due to the time-constrained contracts used by the researcher in his work. However, in order to additionally verify the framework, this approach may be considered for any subsequent research project.
4. Cross-sectional – this approach is typically applied to a deduction-based process involving a preconceived hypothesis. As evidenced by the title of this research, and its intention of inducing a new framework, a cross-sectional approach is not, therefore, a good match here.

5. Comparative – this approach could be applied but the theories available do not address differences such as national or cultural ones. PMMs address some contextual aspects but do not study them in depth. Thus, the comparative approach could require one to make an *a priori* presumption regarding the importance of one or other contextual factors. Such a discussion could potentially be undertaken after the accomplishment of the research project in relation to the accuracy of estimates, once more knowledge of the contextual factors has been gained from the inductive process.
6. Case design based on multiple cases – this qualitative approach, as well as its techniques and methods, may be supportive to some degree in the analysis of the phenomenon of inaccurate estimates. However, it may also limit the framework induction process due to its preferred tools and techniques. Even if "to find the truth" is not the goal of this research, the induction of a framework to improve estimation accuracy is a must. Furthermore, the analysis of a few cases would not assure a wide verification of findings with PM practitioners or the achievement of a socially agreed understanding. Nevertheless, the tools and techniques used for case analysis seem to be usable although they must be tuned and widened to better support the induction process. As Cho and Lee (2014, p.15) indicate within their comparison of qualitative and grounded theory approaches, there is room for discussion over such individual research designs, based on carefully selected tools, supporting an inductive reasoning process.

This short elaboration tends to eliminate some of the approaches listed as the choice, or rather the design, of a research approach should remain consistent with the contextual environment of this thesis, the ontological and epistemological position and, finally, with the problem articulated in the research's title – the problem that calls for the study of estimation phenomena and the induction of a new framework.

4.3 Pilot study

4.3.1 Introduction

A discussion of this pilot study was first provided by Lazarski (2009) and it was adopted for the purposes of the research project. While being aware of the literature related to CCM and BM, an analysis of the conclusions, and in order to reflect on the importance of the overall research project goal and design, it was decided to conduct a small-scale pilot study with two objectives:

1. To verify whether, in relation to CCM, estimating assumptions are consistent with business practice, and whether pessimism-inducing experiences and the application of a reduction to activities' durations ("global cut") predominantly leads to overestimation. Here, in particular, the pilot study adds to the discussion of the literature addressing BM and objective number four, as presented in Section 2.4.4.
2. To deliver additional insights to the discussion of the design of the research. In particular, but not exclusively, to indicate whether this thesis should favour a qualitative or a more customized design with exploration and induction in mind.

4.3.2 Data collection process

The pilot study was sponsored by and conducted in two companies. One was an international automotive enterprise – company T. The other was a representative of the telecommunications industry – company P. The names of the companies were changed for reasons of anonymity. A small-scale survey recruited fifteen people, comprising project managers and team members.

In this non-experimental approach, data was collected in the form of a semi-structured survey. Due to the limited sample size, the data subsequently collected was analysed effectively using Microsoft Excel. The set of questions contained in the survey was strongly influenced by dynamic approaches, especially those coinciding with CCM and its BM as promoted by Goldratt (1997).

4.3.3 Choice of survey questions and survey construction

A list of questions much larger than was required to verify the effect of a pessimistic experience and a “global cut” is provided in Appendix 1. The reason for this was to also test the researcher’s own surveying skills, the associated workload and the feasibility of conducting a wider surveying process. Amongst the questions a few are key in directly supporting the verification of whether pessimistic experience and the “global cut” predominantly induce overestimation. The questions also seek to establish whether there is room for underestimation in CCM and its BM. The key questions which should thus be highlighted and explained are listed below:

1. “Are you involved in directing projects as a project manager? (Yes/No)” and “Are you involved in participating in projects as a team member? (Yes/No)” – these questions verify whether the respondent has a practical involvement in the projects. The literature analysis reveals overestimation as a characteristic of decisions made by projects’ participants.
2. “Are you in any way punished for exceeding deadlines in your projects/activities? (Yes/No)” and “What percentage of your activities is challenged by your supervisor in order to reduce its duration? (0-100%)” – these inquiries directly elicit any negative, pessimistic experience (i.e. being punished) or lack of it. Within CCM, this element is presented as a cause of overestimation alongside the “global cut”.
3. “What factors primarily influence your estimates for the anticipated duration of your activities?”; “How would you best characterize your current motivation system? (give a short description, e.g. keywords describing it)” and “What, if anything, were you afraid of when you got involved in the project?” – these open questions give more insight into the contextual elements shaping the estimation process as well as provide more understanding of the elements of any motivational system. They indicate whether a person could be characterized as having had negative, pessimistic experiences.
4. “On a scale from 1 (I hate it) to 10 (I love it), what number would you choose to characterize your enjoyment of being involved in the project in your company?” – this question aims at a quantitative grasp on the issue of eventual pessimistic experiences.

5. “In what percentage of your activities’ duration estimates do you feel that you tend to overestimate? (0-100%)” and “In what percentage of your activities’ duration estimates do you feel that you tend to underestimate? (0-100%)” – these two questions support verification of whether overestimation and underestimation can coincide.
6. “Would you be prepared to participate in a short focus group discussion (group interview) with reference to the questions raised above? (Yes/No)” – this question supports the collection of further reflections aimed at a deeper discussion of the research design with focus placed on qualitative methods and a more open, explorative approach.

The questions attempt to triangulate and verify from different (qualitative and quantitative) perspectives whether the respondent can indeed be regarded as one representing pessimistic experience and thus as one that will add a margin of safety at each project step (Tukel et al 2006, p.402). The answers collected were quantified according to the rules provided in Appendix 2.

4.3.4 Data analysis

The pilot study undertaken indicates that, regardless of any pessimistic experience, underestimation is possible alongside to overestimation and that CCM and its BM theories are not necessarily coherent with daily business practice. Goldratt (1997) assumed that overestimation is common since “the time estimates are based on a pessimistic experience” (p.50). The survey therefore introduced a control variable in relation to pessimistic experience:

- Being punished or not for missing deadline.

The data collected (and contained in Appendix 2) was analysed with the focus placed on the fundamental need for this pilot study, as explained in Section 4.3.1. To explain the bar chart depicted in Figure 10, the bars have been divided into two groups according to the value of the control variable used. On the left-hand side the bars depict a situation where the pessimistic experience is present. On the right-hand side is a group which indicates the situation where punishment for passing deadlines does not occur.

As can be seen, the applied control variable may indeed coincide with a proclivity to overestimate. In Figure 10 the group of bars on the left, with punishment in place, indicates overestimation in a higher percentage of activities than the group on the right-hand side, i.e. without punishment. This phenomenon of overestimation seems also to interact with the “global cut”. In the left-hand group of bars, the reduction of durations affects a higher percentage of activities and the percentage of overestimated activities also tends to be higher. These reflections may well coincide with the inflated estimates assumed within CCM and its BM.

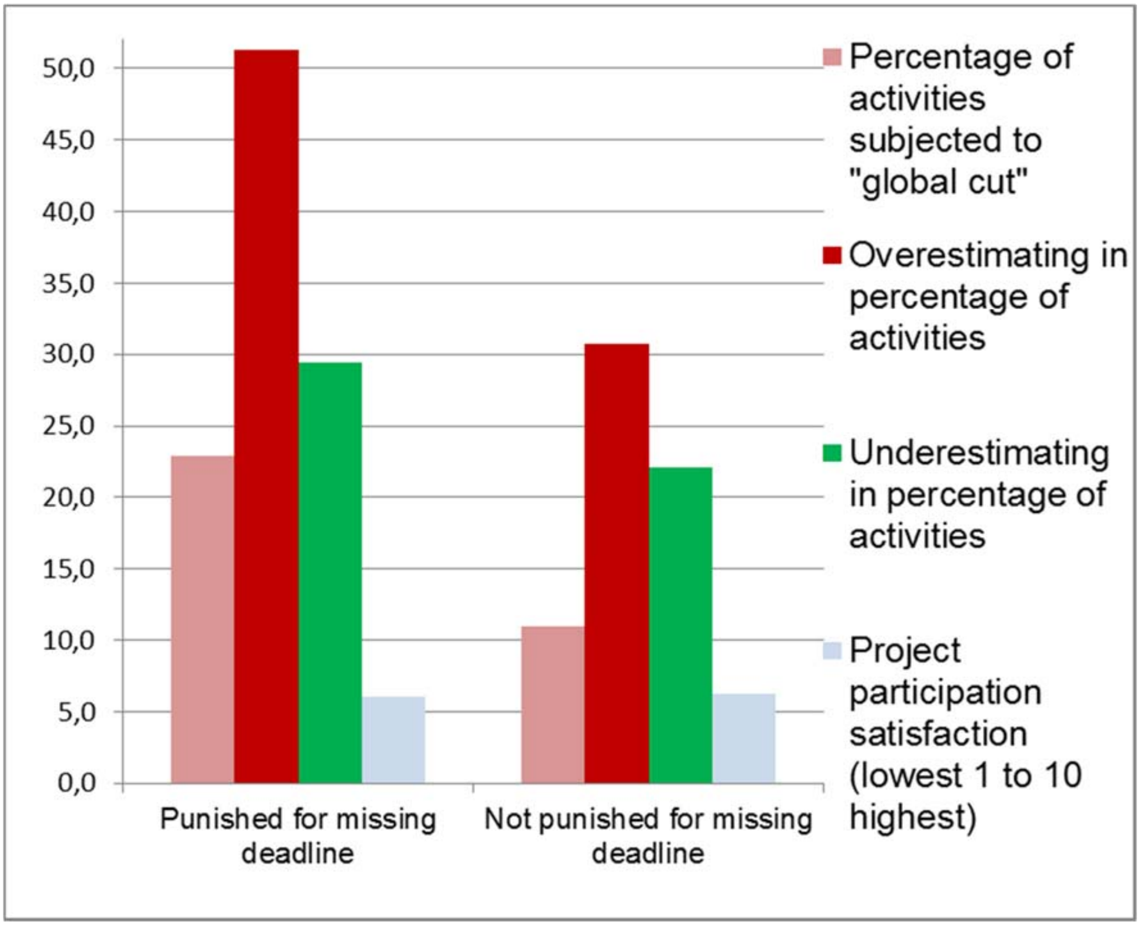

Figure 10 Quantitative data together – companies T & P, Lazarski (2009)

However, underestimation is similarly present in both pessimistic and non-pessimistic situations. Critically, CCM and its BM assumptions should at least decrease the appearance of underestimation where there has been pessimistic experience and a “global cut” is more frequent (left-hand group). Surprisingly, however, in the left-hand group underestimation is still present even where there has been pessimistic experience, and at an even higher level.

It is also interesting that project participation satisfaction does not differ significantly in relation to the applied control variable, i.e. punishment for missing the deadline (pessimistic experience). This raises the question of whether there are other variables as yet “undiscovered”, but it is a question that is outside the scope and objectives of this pilot study.

It is sufficient to say that the pilot study proves that, regardless of the value of pessimistic experience, “overestimation of all activities” does not exist and that underestimation should also be recognized in BM. Thus it should not be surprising that some authors, even if within selected business sectors, continue to argue that “underestimation represents a considerable problem, particularly in public investment projects” (Williams and Samset 2010, p.43). Isn’t it possible, however, that the observed bias at macro-project level may, in some way, mislead by projecting its generalized perspective onto the micro-activity level? What if, within such a situation, a duality of bias (underestimation and overestimation) persists at micro-activity level and affects the individual milestone’s BM?

Alongside the discussion presented in the literature analysis chapter, the pilot study supports the view that specific contextual situations affect human behaviour and the decision-making process, and thus accuracy of estimates. Pessimistic experience may be just one of many influential contextual factors affecting estimates at micro-activity level. Having said that, the logical conclusion is that estimates bias may envelop the same project from both directions – that is to say, underestimation and overestimation are probably due to various contextual factors affecting numerous activities.

4.3.5 An additional qualitative step

As indicated, one of the objectives of the survey was to reflect whether a more qualitative approach would be suitable for the purpose of this research project, and an interesting conclusion was reached which to some extent contributed to the later design of the research strategy. Bearing in mind the immature level of experience in conducting research analysis that characterized the researcher in 2008, the choice of survey content and construction proved rather “fortunate” for subsequent findings.

The survey was semi-structured and its next stage started even more qualitatively, with an additional interviewing process. There was a curiosity to uncover what happened to CCM and its BM overestimation phenomenon. To assure heterogeneous (Robson 2002, p.286) collection of the data, the interviews were conducted individually. The interview was unstructured in form in order to help “the conversation develop within this area” (Robson 2002, p.270).

Interviewees typically extended the CCM assumptions. Their statements suggested that a lack of control over the motivation system, as it was generally understood, was a reason for a more destabilized estimation process. This lack of stability together with related elements that were not always clearly defined – may, in the view of interviewees, increase the level of bias in the estimation process. This resulted in a number of overestimated activities but also in underestimated ones. In general, the qualitative part of the pilot study and its explanatory characteristic emphasized this: that a research strategy should be designed so as to best serve exploration, and that methodology should remain phenomenological.

4.3.6 Potential criticism

Criticism of this pilot study could be directed at the narrow set of questions chosen and the small sample size. In addition, there could be some other contextual variables influencing the collected data or estimation bias that have been omitted and, as already discussed, the number of potential project contextual elements may effectively be infinite. However, with reference to the sample size it is important to recall the objectives of this pilot study. The first was to verify if pessimistic experience predominantly results in overestimation, especially while recognizing CCM’s world of inflated buffer assumptions. The second was to instigate reflections in relation to the research design. These objectives were achieved and are summarized in the following section. Moreover, generalization was not the target of the pilot study and from this perspective, therefore, the small sample size should not engender significant criticism.

4.3.7 Conclusion

Contributions to buffer management

Without wishing to denigrate the work of Goldratt (1997), the results achieved strongly suggest that there is room for further investigation of CCM and its BM. Discussion of the accuracy of estimates would seem to be more complex and should not always be narrowed down to inflated buffers and their reduction in order to provide earlier milestones or savings, and scheduling to the "traceable resource bottleneck". CCM assumptions that advise buffer reduction should be considered very carefully since, in reality, if one acknowledges the presence of underestimates, buffer sizes may be smaller than they appear.

In addition, more focused interviews indicated that discussion should be taken down to the level of micro-activities, and thus should be more individual and have a personal perspective. Furthermore, whilst accepting the duality of bias present (overestimation and underestimation), it may be interesting to focus on a discussion of the conditions leading to the destabilization of a project schedule. In the pilot study, interviewees pointed to a commonly understood and poorly controlled motivation system as the putative cause of such destabilization.

A logical conclusion would be that the motivation to move on with the analysis was supported not only by the characteristics of the research papers on the topic but also by the results of this pilot study. Additional elaboration of the contribution the pilot study made to objective number four, in particular, is undertaken in Section 6.6.2 and, afterwards, briefly in Section 7.2.2.

Contributions to research design

The potential research strategies, as discussed in Section 4.2 and the conclusions of the present pilot study both provide reminders that researchers "following flexible design begin much more generally. They explore." (Robson 2002, p.46). In the view of the researcher, this exploration also extends to the research design itself. The pilot study, and especially its qualitative element, provides specific contributions which remained influential in the research design and final analysis. Thus, the research strategy should:

1. Be able to consider various sources of qualitative data input in order to maintain the process of exploration. In the qualitative part of the pilot study, interviewees through their interaction assured an "effect of surprise". Moreover, it seemed to support an interest in the topic. This was not only one of the most pleasing aspects of the pilot study, but also the most dynamic and emotional.
2. Support, for the purpose of the framework proposition, regularity in the induction process and openness within the framework to incorporate new data and to restructure itself. Presumably, by moving through multiple project stories and collecting experiences such a consensus may be achieved.
3. Allow for a shift of interview questions in order to be influenced not only by literature sources but also to better support openness and development of the discussion during interviews, i.e. not to pre-programme answers but to better identify "what they think, feel and/or believe" (Robson 2002, p.224).
4. Generally, avoid surveying as a method of limiting an open exploration process. Furthermore, surveys could be considered in this context to be impractical due to the likely high number of questions addressing contextual factors, tools and techniques. The larger the number of contextual elements in a survey, the greater the level of non-responses may be observed.

5. Consider the estimation process at the micro-activity level of analysis as well. This affects both the detail of discussions and the preferred sources of data – the preference would be to address team members, project managers and experts to assure more personal, detailed insight. Again, the pilot study helped to raise the question of whether a macro-project's observed estimate bias may be wrongly projected onto the schedule's activities. Overestimated or underestimated projects may impose implicit assumptions of "all-overestimated" or "all-underestimated" activities.
6. Consider several business sectors and thus remain broad-based. Research should not be dominated by a single business sector due to the prevailing risk of analysing a data source that typically has "entirely" overestimated or "entirely" underestimated projects.
7. Enable discussion of objective number four to reconsider BM in the light of these pilot study findings.

In the next sections, the proposed research design "does not depend on *a priori* theories, but uses the data generated by the phenomena" (Collis and Hussey 2009, p.84). Phenomenology and interpretivism "avoid any search for truth, and focus instead on socially agreed understanding" (Jankowicz 2005, p.116). An additional commentary on the contribution the pilot study has made to the research design is contained in Section 7.2.1.

4.4 Inductive methodology

4.4.1 Justification for selecting inductive research design

Concerns associated with inductive research designs

The available literature may lead to some confusion as to whether grounded theory should be considered as an example of qualitative research design. Due to a variety of similarities and differences, authors are able to offer their own interpretations. According to Cho and Lee (2014, p.16), both approaches are based on naturalistic inquiry, they both support various channels of data collection, they both search for codes and categories and they both support an inductive approach.

Differences initially arise in the origins of methods. Grounded theory appeared in sociology; the qualitative approach in communication and linguistics (Cho and Lee 2014, p.16). Cho and Lee (2014) explain that the deliverable "of a grounded theory study is a substantive theory, and that of qualitative content analysis is a list of categories and themes" (p.16). With some simplification, it is possible to say that grounded theory takes the qualitative approach a step further and focuses on dependencies between codes, concepts and categories. In general, it seeks "to move in a systematic way from categorizing data related to a phenomenon toward linking those categories." (Kempster and Parry 2011, p.108). This is the method that is recognized by the researcher as a supportive for induction of a new framework.

Deepening discussion over attributes enabling framework induction

The use of the inductive methods offered depend on the area of application, the limitations and the researcher's approach (Strauss and Corbin 1998). To some extent, therefore, it is up to the researcher as to what methods he or she uses. The procedures offered may facilitate a major criticism of qualitative methods as being unscientific or more journalistic, having no rigour of scientific research (Silverman 2001, p.26). It is useful in the exploration of "particular distinct or unique contexts" (Kempster and Parry 2011, p.117). Project context defines the background of this thesis not only in terms of the framework, but as a key element in fulfilling all of the proposed objectives.

An inductive approach requires practical guidelines and specific procedures which may be used in the iterative process of collecting and analysing qualitative data. The pilot study has shown the value of using a more open approach to better understand the phenomenon. Thus, for that reason, it may also be appropriate to make use of supporting exploration and induction techniques since data collection is often characterized by unstructured or semi-structured interviews (Martin and Turner 1986). Additionally, the theoretical sampling offered may “entail studying documents, conducting observations, or participating in new social worlds as well as interviewing or reinterviewing” (Charmaz 2006, p.107). These data sources are not constrained by the research project’s context and coincide with an applied interpretative, phenomenological approach.

Furthermore, inductive approach methods have many characteristics which focus qualitative techniques. It is particularly true that when searching for dependencies within the conceptual network, analysing it contextually seems to best support the process of inducing a framework. In short, there are specific reasons for making use of techniques and methods typical of an inductive approach: the need for contextual awareness, a methodological ability to engage the generalization process needed to induce a framework, characteristics shared within qualitative approaches, the ability to develop and analyse conceptual dependencies, dedicated software tools able to manage analysis of qualitative data in a systematic and iterative manner, and the coherence between available data sources in this thesis and those used in theoretical sampling. Moreover, the iterative processes of data collection and analysis seem to be reinforced by the characteristics of the research context, as described in Section 1.6.2.

Focus placed on an inductive research design

The context of this research was analyzed in detail to help to formulate the corresponding strategy. Not surprisingly, in inductive research strength “lies in understanding the context within which the research takes place” (Collins 2010, p.43). In inductive reasoning, interpretivism may be related to the soft PM paradigm (Pollack, 2007) where practices “emphasize learning, participation, the facilitated exploration of projects” (p.267). Where an interpretive paradigm is used, an “inductive approach is normally better suited” (Collins 2010, p.42).

The literature search chapter has revealed an interesting specificity in the present scientific discussions, which could be related to the need for searching for the answers to the project's objectives. Thus, within an exploratory focus, the "research follows an inductive approach" (Wilson 2010, p.103), especially if there is little earlier work to address.

Lichtman (2010) indicates that "much of qualitative research follows an inductive approach" (p.213). The overall research strategy is characterized by exploration and an inductive approach which shares characteristics described by Saunders et al (2007). In their paper they emphasized aspects of induction as follows:

1. Getting to know the meanings people attach to events.
2. Understanding of the research context.
3. Collection of qualitative data.
4. A flexible research structure.
5. Being less concerned with any need for generalization.

Even if this view might be considered as quite traditional (Wilson 2010, p.8), it may still be recognized as a good description of the approach applied.

Of course, a framework should not be considered to represent a theory. It would be a precocious statement and conclusion. However, it seems that one or more future research projects, while making use of wider data sources (for example quantitative data sources), could potentially reformulate the framework into a true academic theory. Therefore, the researcher will refer to an inductive approach in order to appropriately underline the intention not of formulating a theory but of defining a framework for improving accuracy of estimates. Consequently, the researcher will refer to an increase in significance or significance level to indicate how many times the specific code and/or concept have been identified within the collected data.

Finally, acceptance of this project major deliverable, the framework, may require a paradigm shift. Kuhn (1996) argues that to achieve paradigm shift in social science, inductive research may be preferred. However, interestingly, Kuhn (1996) indicates that paradigm shift if often pursued by comparatively young researchers. In his view this approach may be more difficult to accept for those researchers with more pre-existing experience of investigation in a subject.

4.4.2 Soundness and trustworthiness of deliverables

The aim is not to find the ultimate truth. It is more about the perception of the reader and the PM community with regards to the trust they might place in the attitude of the researcher, the methods being applied and the findings provided. Thus, saturation level and trustworthiness should be supported by the researcher's overall strategy decisions, the application of specific standards, especially to the data collection and analysis stages. In addition, by the constant, close cooperation with the PM community as depicted in Figure 12. Despite the fact that, in the world of constructivism, "reality" is determined in the individual's mind (Smith 1984), it is hoped that the application of such proactive measures may be viewed positively by the reader.

There isn't a single inductive approach, and each use requires individually configured and applied "safety" measures. Some of them are more universal when referring to data analysis, some of them are configured for, and contextually typical of, individual research projects (Charmaz 2006). Therefore, in order to assure trustworthiness, the following principles were selected and applied at appropriate stages of the work:

1. Researcher's attitudes.
    a. Not to presume superiority of any concept regardless of own previous PM practice and experience.
    b. Limit number of assumptions only to those formally listed in Section 1.5.1.
    c. Stay reflective and iteratively revisit results previously obtained.

2. Literature analysis.
    a. Be aware of existing theories and PM paradigms and their potential influence on the PM community.
    b. Pay attention to criticism or support existing between concepts and writers.
3. Data collection.
    a. Maintain an ethical attitude and apply to research practice.
    b. Make use of the data triangulation achieved through the variety of data sources, the instruments of collection employed, contextual awareness and attention to non-verbal information.
    c. Start the data collection process from a wide, expert viewpoint and then continue in the direction of specific/niche problem-oriented investigations, e.g. practitioners and observations.
4. Data analysis.
    a. Recognize the possibility of influence from PM paradigms on interview responses given. Especially in terms of existing theories and practices identified and described in the literature review.
    b. Maintain coherence in the process of coding the representative concepts and categories.
    c. Consider new explanations even if they fall outside the researcher's own PM paradigm.
    d. Avoid typical pitfalls (Charmaz 2006, p.107) such as:
        i. Premature finalization of categories.
        ii. Unnecessary or trivial categories.
        iii. Trusting in overt statements when verifying categories.
        iv. Using categories that are too generally defined.

Alongside the principles mentioned above, the question could be raised: are there standards available that are universally applicable to inductive approaches? For example, it seems that methods offered by Guba (1981) and Lincoln and Guba (1985) "are applicable for both grounded theory and qualitative content analysis" (Cho and Lee 2014, p.14) and, thus, could be used in an inductive approach. A similar view was also taken by Graneheim and Lundman (2004), especially while looking for methods to enhance the trustworthiness of qualitative analysis. Therefore, on the basis of the views of Lincoln and Guba (1985) and Guba (1981), the researcher justifies the trustworthiness and saturation through reflection on levels of:

1. Credibility.
2. Transferability and applicability.
3. Dependability and consistency.
4. Conformability.

To consider this issue further, Corbin and Strauss (1990) proposed the following evaluation criteria: the quality of concepts and the rigour of research and coding, systematic relatedness among concepts and conceptual network density, range of specificity and variations, theoretical sensitivity, and relevance of theoretical findings (pp. 18-19). However, methods which address theoretical sensitivity and the relevance of theoretical findings are not followed here. This decision is a logical consequence of a plan, at least in this research project, to inductively develop a socially accepted framework in support of PM practitioners rather than a new theory. Thus, Corbin and Strauss (1990) to some extent, and Lincoln and Guba (1985) and Guba (1981) entirely, define the practices of verification of the trustworthiness and saturation levels achieved.

4.5 Code of conduct and ethical issues

4.5.1 Introduction

In a research project, "ethical problems start at the very beginning of a study" (Robson 2002, p.67). To fulfil these ethical requirements, the researcher consistently applies the code of practice for ethics of Bradford University (University of Bradford 2006). From each interviewee, the researcher acquires written consent or verbal confirmation of participation and acceptance of the code of conduct to be used. Through this procedure, the interviewee is also informed of the anonymity rules and the confidentiality agreement.

The person being interviewed is informed of the purpose of the research and, at the same time, an explanation of what will happen on publication of the research findings is provided. The interviewee also decides whether or not to accept specific tools for use in data collection, e.g. audio-video recordings, as well as the location of the interview. It is important that the collecting of data does not cause pressure, embarrassment or harm.

Finally, the principles assuming “mutual respect, noncoercion and nonmanipulation” (Denzin and Lincoln 1998, p.38) are followed. In addition, respect for interviewees is demonstrated “by making concerted efforts to learn about their views and actions and to try to understand their lives from their perspectives” (Charmaz 2006, p.19).

4.5.2 Anonymity and confidentiality

Data is anonymized by omitting sensitive information, e.g. name of the person or organization (de Vaus 2001, p.192). In place of names, short pseudonyms are applied.

The data collected is treated as confidential. Access to the data is granted only to a supervisor and an associate supervisor of this research project. To prevent accidental loss of data, the original source is digitized and encrypted with the use of a 256-bit Advanced Encryption Standard regime. In this particular case, TrueCrypt software (TrueCrypt Foundation 2011) is used. This applies especially to:

1. Recorded audio and video material.
2. Hand-written notes and observations.
3. Copies of documents, if required deleted after use.
4. The transcription process and resultant data.

4.6 Data collection

4.6.1 General strategy

In an inductive approach the methods used involve a number of stages in collecting and analysing data that become merged in research practice, which thus functions as an integrated process representing a repetitive sequence of "joint collection, coding and analysis of data" (Glaser and Strauss 1967, p.43). Nonetheless, for reasons of clarity, descriptions of the data collection and data analysis stages remain separate. When adopting the work sequence provided by Silverman (1993, p.46) for the inductive approach proposed, a simplified list of steps is suggested:

1. On the basis of collected and conceptualized data, attempt to develop categories. Use these categories to systematize and organize the collected data.
2. Develop the significance level of the categories by supporting them with an adequate number of concepts and examples.
3. Axially verify dependencies between categories to assure their coherence with the conceptual network. Develop and evolve a framework according to the concepts and relationships between them. Consider whether the framework could be used in the various contextual configurations identified during data collection.

4.6.2 Access to the data

The researcher has been afforded access to the necessary data because he is cooperating with various enterprises on the topic of PM. For the same reason, it has been possible to collect observations. This should support the induction of the proposed framework and verification of having achieved a socially agreed understanding of same.

Choice of interviewees and other data sources

The selection of interviewees affects the levels of analysis. Qualitatively organized research addresses individuals, members of teams, and groups (Marshall and Rossman 1999). PMI (2013) suggests that, typically, project stakeholders have a relationship with the projects. To provide more detailed descriptions, the researcher has categorized the potential data sources as follows:

1. Experts and consultants – they may give access to conclusions that have already been formulated, supported with cases, and may also be able to offer comparisons of the PM paradigms/strongholds revealed by the study. To be considered an expert for the purposes of this research, two requirements must by fulfilled:
    a. At least seven years of experience in the field.
    b. Occupational contact with more than ten companies a year and/or delivery of presentations within conferences.
2. Project and PM office managers – they may be able to compare and reflect on the accuracy of estimates and overall planning methods. For example, they may observe interactions between projects over the use of shared resources.
3. Project team members – they are on the “frontline” of the estimation process and participate in risk and change management. Both of these practices are engaged (PMI 2013) when updating a previously estimated project plan.
4. Observations – not all data is collected through formal interviews. Opportunities to obtain more inside information often appear at the most unexpected moments. The contextual situation of the research project assures such reflections and surprises (Schön 1991, p.56). This is the main reason for taking observations into consideration.
5. Steering committee members – they are involved in the decision-making process. The need to make decisions upon changes to estimates may (PMI 2013) require the involvement of steering committee members.
6. External or internal competitors – they may affect activities (PMI 2013, p.563), exercise their own interests and thus directly or indirectly change estimates.
7. Other business practitioners not related to PM – this safety measure recognizes that the estimation process (PMI 2013) does not necessarily serve projects alone and may also support other business needs.

Choice of business sectors

Data is obtained from both local and international projects. The focus is placed on European markets, especially in Poland, Germany and other European Union member states. If it is possible to interview practitioners from outside Europe, then this opportunity should certainly be taken. The research does not focus on any specific business sector, as this could limit applicability of the framework or confine results to projects with assumptions of overestimation or underestimation that have only local validity.

Proposed initial contextual perspectives – interview/case categories

In inductive approach, the use of different data sources and different contextual perspectives may support the triangulation process in allowing pieces of evidence to "support and complement each other" (Cottrell 2005, p.143). The strategy applied seeks to avoid any preconceived idea as to the outcome, or any pre-assumed framework. To minimize this risk, the data sources chosen should be those that aid understanding of a variety of contextual perspectives.

These perspectives are somewhat unlimited in their possible configurations but could initially be suggested on the basis of a project's already indicated (Sections 2.3.2 and 2.5.2) environmental factors (PMI 2013, p.29) and other available sources, as recognized within the PM community. On this basis, the interview/case categories proposed are shown in Table 3 with their initial contextual perspectives and characteristics. It is anticipated that these will evolve during the explorative data collection and analysis process.

ID	Interview/case categories	Contextual perspectives & characteristics
1	Expert interview	Interview with expert or consultant unconstrained and independent of any dominating contextual perspective
2	Industrial and service sector	Conditions in marketplace (PMI 2013, p.29)
3	Public sector	Political climate or government standards (PMI 2013, p.29) related to project context
4	Internal projects – delivered to an internal sponsor	Dominating role of internal stakeholders with specific risk tolerance (PMI 2013, p.29)
5	External projects – delivered to an external sponsor	Dominating role of external stakeholders with specific risk tolerance (PMI 2013, p.29)
6	Traditional PM approach which aims to decrease estimates' bias	Organization following paradigm of traditional PMM approach (PMI 2013)
7	Dynamic/agile PM approach which aims to manage or avoid estimate bias	Organization accepting paradigm of "environment of frequent change" (Chin 2004, p.62)

Table 3 Interview/case categories initially proposed

Individual interviews or group-based interviews

To overcome the risk of being homogeneously dominated by one person or group (Robson 2002, p.286), it is preferable to conduct interviews at an individual level. Thus a heterogeneous collection of data is preferred. An exception to this principle occurs in observations and in more spontaneous situations.

Selection of the first interview

The initial data collection iteration must allow for a wider perspective on the topic and avoid a narrowing down of the research problem to any specific business sector. Thus the start of exploration should be based on an in-depth interview with a consultant or expert in the field. Such a person, having observed many project instances, should be a valuable starting point.

This approach does not totally eliminate potential bias, but decreases the risk associated with becoming trapped by any pre-assumed contextual perspective. To further mitigate this issue it is planned to follow the first interview, with another expert in the field. This strategy should encourage the coding and conceptualization process to be conducted efficiently from the outset.

4.6.3 Interviews as a method for data collection

Type of interviews

For the sake of efficiency, it is preferable for interviews to be organized as "intensive" – what Charmaz (2006) defines as a situation in which the "interviewer's questions ask the participant to describe and reflect upon his or her experiences" (p.25). It may not sound innovative but in such a situation it is necessary to ensure that the interviewee "does most of the talking" (Charmaz 2006, p.26) in an open fashion. In such a process, close attention must be paid to minimizing any associated anxiety as researchers "express interest and want to know more" (Charmaz 2006, p.26).

According to Charmaz (2006), an intensive interview allows the use of "observational and social skills to further the discussion" (p.26). Thus, to support this need and to enhance the process of exploration, a semi-structured approach is preferred. Nonetheless, alongside a semi-structured approach there is a need to also facilitate spontaneous interactions. For example, a group-based interview or any other opportunity to collect data that might be supported by the critical-incident technique (Collis and Hussey 2009, p.158). In such situations, unstructured interviews are considered to ease adjustment and help not to bias discussion.

Technical means applied in the interviewing process

The technique for gathering data should be adaptable to the situation encountered. Data collection may be carried out in the workplace, at home, during a business consultancy session or, even more spontaneously, in transit. However, data collection tools should not force anyone to "be faced with situations that cause stress or anxiety" (Robson 2002, p.65). Were this to be the case, then the interviewing process would be thrown into question, both from an ethical and an increased bias perspective. It is, therefore, planned to make use of the following tools and techniques:

1. Video recording – used in most situations. In an attempt to minimize anxiety due to the perceived formality of this method, so-called action-cams are preferred. Their simplified form, lack of a tripod may limit negative impact on the comfort of interviewees.

2. Audio recording – applied if video recording is unacceptable or technically impossible. Audio recording is done with a smartphone. It is necessary to support audio recordings with hand-written notes, in order not to lose non-verbal information. Taking notes does not allow continuous observation of the interviewee and thus carries an implicit bias in missing some (non-verbal) data.
3. Hand-written notes only – may be used by exception. In short, the researcher considers the use only of notes/memos not to be a primary source of information of what transpired or was said.
4. Pictures of graphs, charts, drawings – considered to be useful since they may support interviews and observations and broaden overall understanding.

An openness toward other potential technical means is maintained. However, the researcher generally tries to avoid telephone interviews, for example, because they limit the observations that can be collected: a more interactive and natural face-to-face interview is always preferred.

Presentation of the current research state to the next interviewee

This presentation is limited so as not to influence or cause bias. Interviewees should not be given any presumed earlier assumptions. Information about the project is revealed concurrently with ethical requirements. The current state becomes more visible in a shift of questions or topics that are the subject of investigation. However, information about this change or shift in approach is not revealed.

Further development of interviewing skills, tools and techniques

The aim must be to continuously improve research tools and techniques, especially in sustaining an openness in approaches toward the collecting and analysing of data. It may support the study’s contribution to applied research tools.

4.6.4 Documentation and other files

During the interview process it may be that the interviewee supports his or her evidence with documents, graphs or diagrams. If this happens, the researcher should not oppose this but simply assure a consistent approach to the legal and ethical requirements in respect of such material. Any such documentation becomes part of the data-analysis process and remains exclusively linked to the individual interviewee in question.

4.6.5 Observation as a method of collecting data

Traditional view

According to Schwandt (2001), in using an observation the researcher has to become “at least partially socialized into the group under the study to understand the nature, purpose, and meaning of some social action” (p.185). This view is shared by Gillham (2000) and Murphy et al (1998). It may place observations close to ethnography and put the information gathered in a broader social context. Observation requires that “the observer gathers data on daily life in the group or setting under study” (Murphy et al 1998, p.7).

Types of observations, their usage and potential drawbacks

The contextual aspects of this research project, constraint possibility of being permanently involved in any one organization. However, observation is central to qualitatively organized research and thus visits to various companies and, if possible, more frequent visits to selected ones may be organized. Furthermore, “many qualitative researchers employ intensive interviewing exclusively, without systematic observation of respondents in their natural setting” (Bachman and Schutt 2010, p.275). Thus, observations may supplement the data collected through an intensive interviewing process.

It is anticipated that observations may be collected not only during interviews but also whilst in the following situations:

1. Being at the workplace of an individual interviewee – during the research project this is a place in which the discussion of PM practices is frequently observed, and most visits to specific companies last from one to a few days.
2. Having an opportunity to observe or discuss the subject during the delivery of consultancy services or attendance at conferences.
3. Frequent visits to the same site (factory, office, company) – this is out of the researcher's direct control but if the opportunity presents itself it should be taken in order to deepen observations.
4. "Closed" mentoring sessions – dedicated to one company.

One drawback of observations might involve the influence of the researcher on the environment being observed, which cannot always be avoided. Especially when considering more frequent interactions. It should be noted that bias can also arise as a result of consulting, of occupying an established conference-speaker role or, most simply, of one's own presence. For this reason, where necessary, the observations collected are marked to indicate potential bias.

Notes and audio memos

While collecting observations the researcher takes notes and records audio memos to grasp immediate reflections, apply commentary and to identify further areas of interest. Where available, notes and audio memos are aligned to the timeline of an observation or the timeline of the recorded material obtained, relative to the interview. This allows the linking of data sources, regardless of their physical form.

Appendix 3 describes the document layout for the collection of notes and observations. It consists of three major sections. The first one tags potentially biased data, the second describes what transpired, while the third focuses on the commentary and reflections of the researcher. The commentary may define the timeline, further questions to the interviewee or may indicate a general need to deepen knowledge of a selected topic and, a code, concept or category.

4.6.6 Timeframe and intensity of data collection

Interviews timeframe

Interviews started very early in 2008 during the pilot study. Apart from the two objectives of the pilot study, the intention was also to develop the interviewing skills and competences of the researcher. At the very beginning, interviews were also conducted to build up relationships that would allow the possibility of selecting, at a later stage, from a range of potential data sources. Thus, interviewees were selected with attention paid to the cognitive process and the need to create a framework and support research needs as they were encountered. In 2012 and 2013, interviews were totally subordinated in service of the strategy defined by an inductive approach and could be characterized by:

1. Closely following chosen strategy of merged data-collection and analysis processes.
2. Utilizing planned timeframe with an emphasis placed on 2012 and 2013.
3. Applying and strictly adhering to anonymity, confidentiality and overall ethical standards.
4. Making use (at the beginning of the inductive process) of the initial set of questions, which were adjusted further during the interviewing process.
5. A logical sequence of coding process, revealing uncovered areas and thus supporting the selection of data sources and the development of interview/case categories.

Each interview should last at least 40 minutes, but it was not planned to conduct any interviews longer than 90 minutes. Nonetheless, if necessary, the researcher might re-interview with additional questions.

Observations

Observations should be collected alongside the process of interviewing, although the frequency of collecting observations is expected to be higher than the number of interview meetings. This is mainly a consequence of the researcher’s professional responsibilities, which allow more frequent contact with a large number of PM practitioners.

Planned number of interviews and observations

A minimum of ten intensive interviews should be organized, represented in Figure 12 by the "Stream – 1" process. This is supported by the similarly depicted "Stream – 2", which allows a choice of interviewees and a more systematic verification as to whether a socially agreed understanding of the framework and its know-how in terms of application is being achieved. It means that there are hundreds of workdays of additional meetings documented, dedicated to studying best PM practices. Nevertheless, it is assumed that the increase in saturation achieved through evidence collection should define the end of the merged data collecting, coding and analysis process.

4.6.7 Initial interviewing questions

Interview questions pay close attention to the five research objectives described in Section 1.5.3. However, in the "full picture", the questions shown in Table 4, were formulated on the basis of the:

1. Research assumptions.
2. Research objectives.
3. Literature review.
4. Pilot study undertaken.

In addition, the title of this research demands a focus on a project's contextual elements, tools and techniques in order to formulate a framework for improving accuracy of estimates, rather than on particular PMMs. In initial questions, an exception is made only to ask about perceptions of traditional and dynamic/agile approaches, as justified by the fifth of the research objectives.

The pilot study, amongst other considerations (Sections 1.6, 2.5.2 and 4.2), indicated that the explorative and inductive processes would better support the research goal than a survey-based one. It could also be argued that a more open, semi-structured interviewing process is generally preferable. Thus, the accepted way of formulating questions is to start with the words "what" or "how"; the word "why" was not used because it could imply an inappropriate causality relationship (Creswell 2009, p.130). The following constitutes a list of the initial, interviewing questions:

ID	Questions	Explanations, literary sources
1	What is your general point of view on the accuracy of estimates in PM and in general business practice?	This is an open, unstructured approach. It helps to manage more spontaneous situations like those related to critical-incident technique (Collis and Hussey 2009). Also, it does not suggest, at the start of the interview, any pre-assumption of problems in estimating.
2	What key factors lead to overestimation?	Goldratt (1997) claims that "the time estimates are based on a pessimistic experience" (p.50), what through CCM and its BM becomes recognizable to PM practitioners. Unlimited list of enterprise environmental factors (PMI 2013, p.29) which may influence projects.
3	In your view, what key factors lead to underestimation?	In the pilot study, Lazarski (2009) demonstrated the possibility of underestimation in a CCM's BM. Again, unlimited list of enterprise environmental factors (PMI 2013, p.29). Underestimation is recognizable (Flyvbjerg et al 2002a, 2002b; Williams and Samset 2010).
4	How can you improve the stability of schedules during project planning and execution phases?	Understanding project context "helps ensure that work is carried out in alignment with the goals of the enterprise and managed in accordance with the established practice" (PMI 2008a, p.17). Usable and available organizational process assets (PMI 2008a, p.32). Methods applied in "agile environment of frequent change" (Chin 2004, p.62). RM may "decrease the probability and impact of negative events in the project" (PMI 2008a, p.273).
5	In your opinion, what PM methods could be applied to improve accuracy of estimates? And when?	Credibility and "confidence level of estimates is directly related to the activity definition and available information" (PMI 2011, p.12). At the beginning of a project's lifecycle there is a "reduced accuracy of estimate" (PMI 2011, p.12). Exclusions (PMI 2013, p.123) may limit number of estimating cases. Correct sequencing of activities (PMI 2013, p.143) may assure information necessary for subsequent estimation process. Estimates may be hindered by "lack of information required to quantify/qualify risk estimates" (Kutsch and Hall 2009, p.73). "The accuracy of activity duration estimates can be improved by considering estimation uncertainty and risk" (PMI 2008a, p.150).

6	In what situation should traditional or dynamic approaches be applied? To explain, what is your perception of more dynamic/frequent or static/fixed scheduling?	General perception from the literature analysis suggests the presence of these two paradigms. There are also other approaches available: contextually focused approaches (Kruchten 2013) or more hybridized approaches (Binder et al 2014; Jahr 2014; Špundak 2014).
7	In your view which sequence of estimating should be applied when referring to duration, workload, resources, cost?	Within related variables “estimating process develops a prediction of how many resources the project will use, how much the project will cost, and how long it will take” (PMI 2011, p.34). When “resource has been assigned to two or more activities during the same time period” (PMI 2013, p.179), resource levelling may affect related variables, e.g. duration.
8	How may information and communication technologies improve PM practice?	Software “will speed up data processing if the information system has been well designed” (Burke 2003, p.323). When discussing support of portfolio management, Seider (2006) points to Microsoft Project as too “clumsy to use” (p.43).
9	Should PM practitioners follow project management methodology processes or develop them for each project instead?	“Are projects best managed by rigidly enforcing every detail of all the processes, or by drafting a completely custom process for each and every project?” (Fewell 2010, p.27). PMM control and standardization – a “large proportion of practitioners (47.9%) disagreed that this fulfilled their expectations for effective project management” (Wells 2012, p.57). Similarly, Gemino et al (2015) point to value of tacit knowledge.
10	What is the role of knowledge and lessons learned in the estimation process?	Improvement in learning from projects is slight (Hartmann and Dorée 2015) and the learning process often fails (Atkinson et al 2006; Keegan and Turner 2001; Kerzner 2000, 2009; Klakegg et al 2010; Milton 2010; Williams 2008; Wysocki 2009).

Table 4 Initial questions in semi-structured interviewing process

This list of leading questions provides an initial form but, in each interview, openness of discussion remains the most welcome element. In practice, many more questions were asked. The most informative ones were those directly addressing contextual background or which brought up specific project cases and real-life stories.

4.7 Data analysis

4.7.1 General strategy, focusing and decisions taken

Data analysis should reinforce the scientific attitude that “research is carried out systematically, sceptically and ethically” (Robson 2002, p.18). The interviews used open questions, not significantly influenced by any PM paradigm. Involving two experts at the starting point of an inductive approach indicates awareness and mitigation of the risk that any “views held by the researcher prior to the study may restrict his or her perception of the phenomenon” (Collis and Hussey 2009, p.157). To decide what kind of tools should be applied in the analysis, the researcher took into consideration:

1. The different sources of collected data: audio, video, written notes, recorded memos, documents and pictures.
2. Sources of data that are typically semi-structured or, to some degree, unstructured.
3. Ergonomics and feasibility of analysis.
4. The potential number of interviewees, observations and related project cases.
5. The potential for an expanding number of codes to become subject to a subsequent recoding and reanalysis process. Inductive approach requires an iterative practice where conceptual networking is the subject of change.
6. The potential presence of multiple codes linking to one data source alongside the more obvious situation of having one specific code linked to many data sources.

The coding process segments data into labelled chunks. From the perspective of ergonomics, it is necessary to assure the traceability of the cognitive process, especially when analysing links between concepts, categories and sources of data. Thus, the practice of this research project should be supported effectively by IT. The research entails the following decisions in relation to the technicalities of data analysis:

1. Data collected mainly as recorded audio-video material must be synchronized along its time axis with a coded transcript to assure backward traceability.
2. Data is investigated with support of Computer Assisted Qualitative Data Analysis Software (CAQDAS) (Easterby-Smith et al 2008, p.187).

4.7.2 Preparation of the data for analysis

Data analysis requires “identification of essential features and the systematic description of interrelationships among them” (Wolcott 1994, p.12). Transcription could be described as a process of fastidious documentation of what was registered in an interview. It captures not only what was said but may refer to observations, body language, displays of emotion, notes, memos, the moment at which some document was handed over, and even environmental conditions related to the interviewing process.

Logical levels of analysis

Data analysis considers various levels (Orlikowski 1993). Thus, the data sources presented earlier in this chapter provide numerous possible levels (Yin 1994) through specific cases. Focus is often placed on organization, teams or groups, individual persons or processes (Marshall and Rossman 1999). Listed below are the levels of analysis that were proposed and confirmed in the research practice:

1. Project team member.
2. Project manager.
3. Project contextual element, tool and the characteristics of the organization running the projects.
4. Major stakeholders, i.e. customer, sponsor, supervisor.

Transcription process and language-related considerations

Most importantly, recorded materials and observations require transcription before any other analysis tools can be applied. At first it was planned to contract this work to a dedicated service provider but, after having analysed initial samples, the researcher undertook the transcription himself. This decision was made despite it being more time-consuming and, at the outset, a challenging task. There were several reasons for this approach:

1. The hermeneutics of PM-related language which was not always correctly transcribed or was sometimes, when professional terminology was being used, translated unnecessarily.
2. In the opinion of the researcher, the initial samples offered insufficient commentary on other related aspects, for example, emotions and non-verbal information.
3. The decision to keep transcriptions, where possible, in the original language of the interviewees in order to minimize the additional bias related to translation and allow the coding to be simultaneous with the transcription process, which appears to be more natural and less prone to error. Moreover, it supported the decision to keep the process of transcription and coding linked and carried out by one person – the researcher. Transcription provided the researcher with the opportunity to become familiar with the data at a very early stage of the research (Murphy et al 1998).

Technically, the chosen unit of analysis was defined as the text line within the transcript since it was easier to refer back to the line number in the transcribed data than to a sentence number.

4.7.3 The iterative process of coding

Through the coding process "data are fractured, conceptualized, and integrated" (Strauss and Corbin 1998, p.3). Microanalysis relies on a set of tools, especially on open coding, on asking questions and on related comparisons between data. This process depends strongly on textual analysis providing insight primarily on exactly what was said.

The open coding process

Open coding is used to identify concepts and define related categories. It is applied through the analysis steps as follows:

1. In the first step, open coding assists the initial conceptualization of the collected and transcribed data. This process scrutinizes the collected data line by line. At this stage the researcher applies codes to all pieces of information.
2. If codes are repeated or are similar then they are grouped to better present visible ideas/concepts. At this stage of the analysis, concepts are labelled to present a more structured approach. Labels might be defined by making use of personal knowledge (Strauss 1987, p.33) but also from interviewees' reflections or input from the literature review, particularly where it concerns more PM-specific terms and wording. To reduce potential misnomers, attention must be paid to ensuring that there is no conflict with common meaning, related paradigms or understanding of the label used (Johnson and Duberley 2000, p.72).
3. Concepts are networked to support the subsequent process of axial coding. The conceptual network thus obtained is updated after each new interview, each new analysed case and each new observation. It is anticipated that this network may become quite complex as it is developed at a level below that of categories. The researcher also tries to define and confirm types of dependencies between the concepts. The conceptual network illustrates a response to the question of what influences the accuracy of estimates, and becomes the basis for framework formulation.
4. Subsequently, concepts are collapsed into categories and subcategories. This process is continuously supported by additional interviews. It may also require a more iterative approach and therefore additional recoding of transcripts that have already been coded. In addition, it may be that some concepts and categories are identified in a newly transcribed interview which had not been detected in an earlier one.

The axial coding process and observed dependencies

Axial coding follows through these next steps of analysis:

1. After having completed the last step of the open coding process it becomes possible to connect "categories and subcategories" (Collis and Hussey 2009, p.179) in order to present dependencies, patterns, links and relationships (Saunders et al 2007, p.499). As such, it could be regarded from this point as a "pattern for the whole", achieved "by relating the codes or categories to one another" (Schwandt 2001). Technically, an axially coded network could be recognized as a more generalized view of the previous, conceptual one. However, dependencies are here established not between codes and concepts but between categories and subcategories. Nevertheless, these two networks do not contradict each other but instead become complementary and both support understanding of the phenomenon under study.
2. After a certain number of cycles – making use of subsequent cases, interviews and observations, it may be possible to start to formulate a framework. Then, in the case of each proposed tool or method, additional discussion may be used to verify consistency within the collected data. The chosen methodology is expected to confirm the link between the project's contextual situation, the methods applied and the improvement in accuracy of estimates.

The selective coding

Subsequent coding may be based on a selective approach to help identify the core category in relation to the other categories (Collis and Hussey 2009, p.179). According to Strauss and Corbin (1998), this involves choosing one major category and linking other categories to it. This technique may be applied at a certain point in the research to support development of a more focused, explanatory framework.

Number of iterations

The number of iterative cycles in an applied inductive approach is not specifically limited according to the literature, which may indicate that the process should "stop" on its own. To manage the curve of saturation increase, interview/case categories have already been suggested, and it was proposed to start with two experts in the field. In addition, the researcher has adopted an approach provided by Lincoln and Guba (1985) and Guba (1981) (described in Section 4.4.2) to support the justification of the trustworthiness and saturation level attained.

4.7.4 Potential form of the framework

A number of possible forms for the framework may be considered. Firstly, it might take a tabularized form with a multidimensional presentation, in which the outstanding question concerns how many dimensions should be used to support the contextually constructed reality. A second approach could be to formulate the framework in a questions-and-answers form. Such an approach could require, a decision with regards to sequence of verification of contextual factors. Finally, it may be possible to present the framework in a form that is conditioned by contextual best practices, which might take the form of an audit process associated with an evaluation and weighting system. At this stage it is difficult to decide which form would be the most suitable, and the answer may depend on interviewees and the PM community also offering opinions on this question.

4.7.5 Use of Computer Assisted Qualitative Data Analysis Software

Justification of choice and use

Two CAQDAS applications have been taken into consideration: Atlas.ti and NVivo. The choice concentrated mainly on the ergonomics of analysis and the security of data storage. On the basis of these aspects, Atlas.ti was selected. This software uses hyperlinks that direct the user to the data captured and doesn't merge all recorded documents into a single, large file, which would adversely affect its ergonomics. At an advanced stage of the research project, such a single file might be considered to be a critical performance-inhibiting element, as well as rendering the project more vulnerable to a data loss should that file become lost, damaged or corrupted.

Sequence of work with Atlas.ti

Atlas.ti supports scrutiny even in situations of increased complexity but it does demand orderliness of work. Thus, workflow in Atlas.ti is defined as follows:

1. Create an analysis project – a hermeneutic unit.
2. Add data sources and link them to the transcribed text.
3. Create “free quotations” within the transcribed text or straight from the audio-video recording. At the time of their creation, “free quotations” are not connected to the codes but can be assigned to them afterwards.
4. Define codes and link them to the “free quotations” or directly to the transcript. In the iterative process of coding, conceptualize and group-label them.
5. Formulate categories and subcategories by applying Atlas.ti code families.
6. Establish dependencies between codes and concepts by using Atlas.ti networks.
7. Continue axial coding and establish/verify dependencies between categories and subcategories.
8. Reanalyse framework.
9. If and when visible on the basis of conceptual and axial relationships, select core categories accordingly.

4.7.6 Summary of the data collection and analysis process

An inductive strategy implies an iterative process of data collection and analysis, managed by CAQDAS. To summarize, better visualize and explain the sequence of each iteration, the steps included were graphically captured via the following diagram:

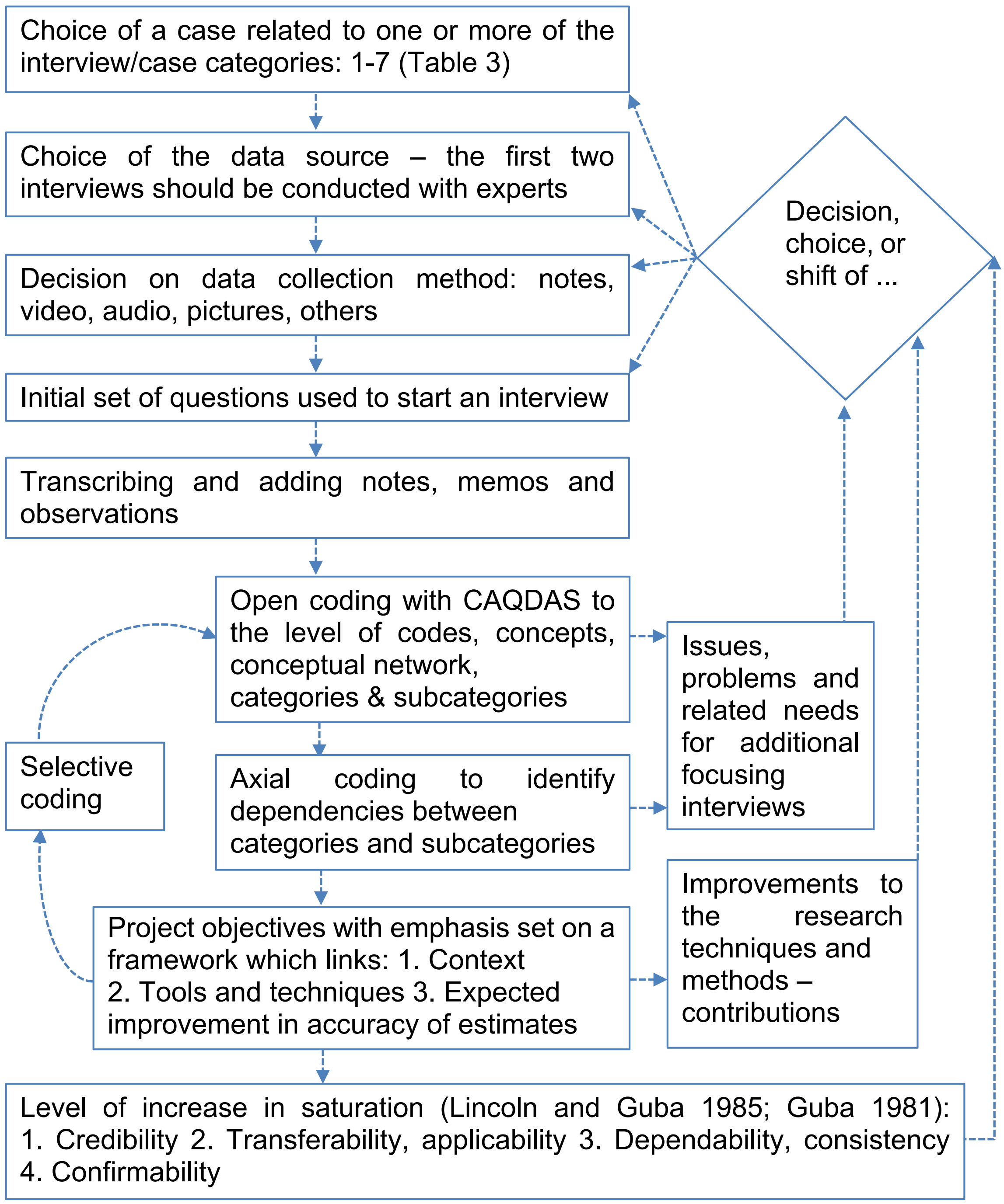

Figure 11 Iterative data collection and analysis process

4.7.7 Risks related to the research strategy model selected

The research strategy model, as presented in Figure 11, is not without related risks and limitations. For example, it requires commitment to a time-consuming transcription process. There is also a risk of wrongly allocating categories, subcategories and concepts (Bryman and Bell 2007, p.591). Moreover, the wrong choice of interviewees and the consequent omission of important concepts may constrain the comprehensive applicability of the framework induced. Closely related to this problem are, in addition, risks associated with the over-structuring of interviews and not recognizing the necessity to shift the question set during a data collection exercise. However, these risks do not undermine the use of an inductive approach, as designed, in an efficient exploration of the phenomena in question. Rather, they indicate the need for adaptability, and not limiting any uncovered directions of investigation.

4.7.8 Research process development, data sources and investigation directions along time axis

Major data sources, interviews – abbreviations used

The following is the list of data sources, presented in the sequence of their use. It covers the pilot study, interviews, observations and PM community debriefing. Conceptualized data source indicates whether it was an element of the conceptual network development and an element of the discussion (Figure 12, Chapters 5 and 6) leading to the fulfilment of the project's objectives.

Abbreviation	Description	Data source
P	Company P	Survey – pilot study
T	Company T	Survey – pilot study
P1	Expert	Interview – conceptualized, "Stream – 1"
M1	Expert and pioneer in the field of project management	Interview – conceptualized, "Stream – 1"
S3	Public sector practitioner	Interview – conceptualized, "Stream – 1"
R1	Public and education sector practitioner	Interview – conceptualized, "Stream – 1"
OB1	15 people from various companies, 3-day-long observation	Group interview – conceptualized, "Stream – 1"
K1	Expert	Interview – conceptualized "Stream – 1"
OB2	IT company – 4-day-long observation	Two group interviews – conceptualized, "Stream – 1"
S1	IT sector practitioner	Interview – conceptualized, "Stream – 1"
A4	Practitioner	Interview – conceptualized, "Stream – 1"
K3	Expert, automotive sector	Interview – conceptualized, "Stream – 1"
OB3	International corporation – 45-day-long observation	Numerous data sources – conceptualized part of "Stream – 2"
	PM community debriefing – 425 days	Communicating the framework concept to the PM community, development of the researcher, interviewee identification, "Stream – 2"

Table 5 Major data sources – abbreviations used

Exploratory process

Figure 12 the time axis is organized from a top-down perspective. The illustration is supported with selected reflections extracted from the research process. From the top, it is graphically arranged into the two “streams” of the research process, which are defined as follows:

1. “Stream – 1” depicts the major analysis process and pilot study. The inductive reasoning process starts with an expert P1 (Table 5 contains the data sources conceptualized) and proceeds through subsequent interviews and observations while repeating the iterative process presented in Figure 11. These steps, and especially the additional comments, are presented in detail in Chapter 5. It all serves to increase the significance and density of the conceptualized network that defines the cognitive basis for the achievement of the research objectives. This aim is enhanced by focusing and deepening discussions as described in Chapter 6. There the pilot study also provides its contribution to the final analysis, which is subsequently recapped briefly in Chapter 7.
2. “Stream – 2”, additionally described in Appendices 5 and 6, is dedicated to verification of whether a socially agreed understanding of the proposed framework was achieved, whether it was derived in a context of continuous communication, and whether it can be positioned within PM practice. Formally, this stream could be considered as an example of peer debriefing but also as a source of additional observations, offering support in the identification of interviewees and maintaining the development process for the researcher in the field of PM. However, two important comments should be made: firstly, it addresses a much larger group of people than does the usual peer debriefing; secondly, it mainly depends on many shorter-lived contacts, lasting a few days at most. In essence, this practice may be referred to as “PM community debriefing” or “peer review”. On this occasion, “Stream – 2” was built up on the basis of 425 days of meetings held between 2008 and 2014, and on 45 days of observation OB3 conducted from 2012 to 2013.

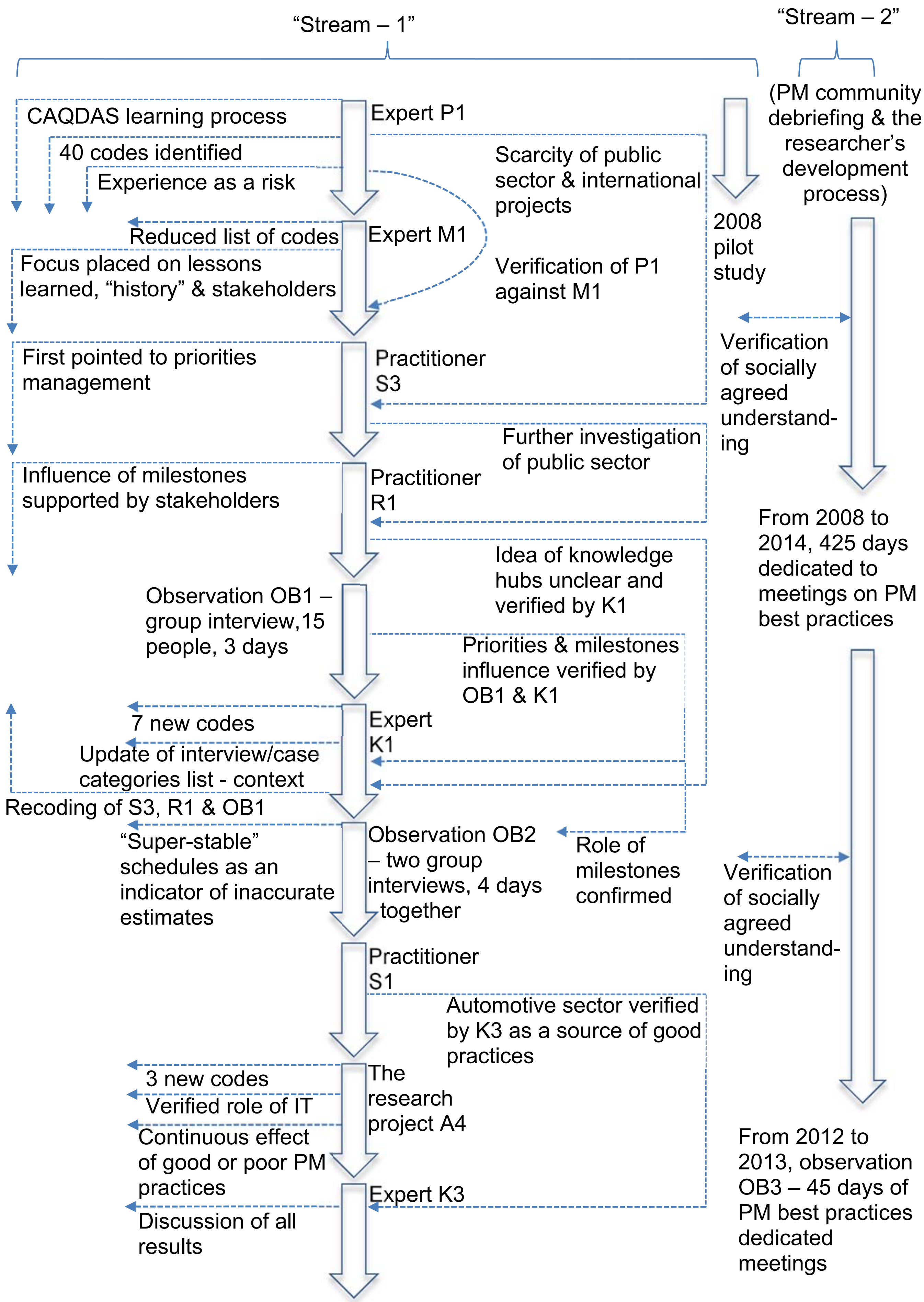

Figure 12 Research process development sequence

4.8 Conclusion

Data collection and analysis proceed iteratively through each loop of conceptualization in order to increase saturation. In short, these looping stages can be characterized similarly to the ones proposed by Huberman and Miles (1998):

1. Data reduction.
2. Subsequent data display.
3. Conclusion drawing with related verification.

The data reduction may not always be intentional and may be related to the instruments and tools used to collect the data. To minimize unintended reduction, this research makes use of various data sources and data collecting methods to reinforce the triangulation process. However, when viewed from a conceptualization perspective, an intentional reduction occurs as a consequence of open and axial coding and the clustering of data, which entirely suits the purpose of this particular analysis.

The inductive approach was designed while focusing on the use of inductive research methods and the conclusions derived from a pilot study. Moreover, an important factor motivating the formulation of an inductive approach was the type of research question, and research objectives that were contextually dependent. Among them all is the search for the opportunity, to some extent only, to generalize a new framework within the conceptualized and networked data. Since a new theory is not the goal of the present research project, the "risk of not generating significant theory despite the time and energy devoted" (Cho and Lee 2014, p.15) is thereby avoided. However, this should not diminish the value of the new framework to PM practitioners and the PM community. Furthermore, as was discussed in Section 4.4.2, the verification of trustworthiness and saturation level was designed to provide the best and most appropriate degree of correspondence to the specific research strategy developed for this project.

5 Use of research strategy in making sense of overestimation and underestimation phenomena in PM

5.1 Introduction

This chapter presents details of the series of interviews and associated case studies and observations undertaken during the project. It follows the explorative and inductive research sequences depicted in Figure 12. In order to reduce potential bias, the research process focuses initially on the input provided by two experts, and then makes use of practitioner interviews and observations to better understand contextual perspective. The researcher consults experts again, at a later stage, in order to improve the trustworthiness and saturation level of the findings. In addition, a systematic dialogue with the PM community is maintained throughout with regards to these findings.

An inductive approach was used to make sense of what causes underestimation or overestimation in PM. This approach was operationalized by carefully codifying the data collected, and this is presented in the following sections. The exploratory process depicted in Figure 11 is followed by focusing on data analysis, presentation, justification and categorization of the newly defined codes and concepts. The list of codes was kept as short as possible by reviewing them frequently, with careful attention given to potentially similar descriptions of different codes. The individual concepts identified often became valuable PM tools and techniques, such that categories or subcategories could become groups of such tools. Additional analysis, leading to fulfilment of the research project objectives listed in Section 1.5.3, is contained in Chapter 6.

5.2 Expert P1's experience

5.2.1 Choice of interviewee

P1 is an expert in the field of PM with more than eight years of experience in consultancy. He supports more than ten companies a year. P1 is well known to the business market in Poland and provides a clear view of many aspects of PM. He is also a member of the IPMA. The interview linked him to more than one of the interview/case categories defined in Table 3, and especially to external and internal projects.

5.2.2 Data collection

Place, time and tools

The first interview was conducted in a hotel room, the second was two-hours long and carried out over dinner. The formal part of the interview was audio recorded. It was not possible to use video recording. During the interview an additional, template (Appendix 3) was used to collect memos and notes.

The process of interviewing

Generally, due to previous experience in similar activities, the level of stress was unnoticeable and discussion was very lively. P1 provided clear answers to many questions but due to his dominant nature it was not possible to follow strictly the predefined sequence. He preferred to tell "stories". Thus, the interview was accomplished not primarily from the perspective of the initial sequence of questions asked, but more from the perspective of all the problems expected to be covered within the discussion.

An initial set of questions (numbers one, five, six, seven, eight, nine and ten) were used from Table 4. Questions number two and three were not directly asked because the interviewee referred to them while answering other questions. While giving examples, he was not aware that "between the lines" he gave answers to other inquiries. These two conversations were recognized as intensive ones.

5.2.3 Data analysis

CAQDAS system learning process

The interview with P1 not only provided valuable data input but also verified the research techniques within the inductive approach. It was – certainly in comparison to all subsequent interviews and collected observations – the most crucial one, technically speaking. The coding process was conditioned by mastering the functionalities of CAQDAS. At the end, though, a satisfactory level of working with the Atlas.ti software was achieved. Additionally, the researcher started to propose improvements which may help to make more efficient use of CAQDAS in inductive reasoning processes. These are explained in Section 6.9.1.

Transcription

The transcription and open coding process were carried out simultaneously. The transcript was prepared in the Polish language – mother tongue of the interviewee. Codes were applied to quotations and named in the English language to assure a future homogeneity of analysis. The consequence of this practice was that in vivo coding was somewhat limited. Therefore, to support the "feeling" of codes, the researcher applied individual comments to most of them. Citations presented within the analysis were translated into English.

Identified codes

Audio recordings were linked to the transcript and synchronized. It allowed traceability of the text to the original audio file. It became especially important in the final part of the coding process. Synchronization between transcript and audio recording allowed the double checking as to whether the application of already-used codes could be justified. Synchronization also supported the process of linking memos and notes.

The coding process went through a few iterations. It helped to effectively decrease the number of codes and supported the conceptualization process. After the third iteration of coding, the list of codes was shortened to forty. Significance of ideas and concepts became defined by references to the transcript text. However, the significance level remained low for many codes.

Furthermore, the labels of many codes were simplified to improve their readability. In the majority of codes, labels were based on “what was said” but also on the basis of available literature and the researcher’s own PM knowledge. Similar incidents were merged and similarly conceptually labelled. Subsequent intensive interviews would bring more opportunities to improve significance of the new concepts and categories as well as verify the label names. As already indicated, in order to prevent loss of the conceptual meaning of codes most of them were supported with comment. Each individual use of the same code was supported with additional comment. Therefore the most frequently used codes and concepts became ones to be the best described.

Table 6 provides the complete list of codes and concepts identified and conceptualized by the researcher. The data was divided into discreet parts in order to support further development of the conceptual network. In explanation of the table: the “Sig” – significance header depicts how many times a certain code or concept was identified in the transcript. Consequently, “Den” – density corresponds to the number of conceptual network dependencies identified and connected to a specific code or concept. The presentation of the most significant codes and concepts takes place in the following sections.

Codes and concepts	**Sig**	**Den**
Parametric tools and methods	3	3
Not every team member is capable of working in PM environment	3	2
No significant bias in engineering, if scope is well known and know-how is verified	2	4
IT and service sector projects	2	4
Abandon detailed estimating and try to fit into scope during execution phase	2	3
Overly optimistic	2	3
Insufficient knowledge of scope of activity	2	2
Lack of technical know-how	2	2
Overly pessimistic	2	2
Methods able to increase accuracy of estimates	1	15
Projects with scope to be defined during a project life cycle	1	7
Knowledge is hidden in lessons learned	1	5
Customer/stakeholder focuses on global estimates	1	4
Customer/stakeholder is part of the process and accepts methodology	1	4

Engineering, construction industry projects	1	3
Experienced have tendency to overestimate	1	3
External stakeholder – within formalized work environment	1	3
IT databases support estimates when parametric models are used	1	3
Methodologies are used to support immature organizations	1	3
Milestones and deadline oriented schedule	1	2
Do not estimate what is unknown	1	2
Simple IT tools used due to too expensive sophisticated ones	1	2
Internal stakeholder	1	2
Work with rolling-wave planning	1	2
Public and education sector projects	1	2
Misunderstood or wrong know-how	1	2
Too much experienced and managing mistakes	1	2
Experience as a risk	1	1
Focus on lessons learned KPIs and not on business goals	1	1
Focus on business goal and not on a product goal	1	1
Less experienced are estimating only on the basis of a description of functionality	1	1
KPIs should be removed from lessons learned	1	1
Context-dependent, known methodology does not exist	1	1
Consulting services	1	1
PM certification is a business product for sale	1	1
Age and experience	1	1
Relationships between team members and time on projects	1	0
Is bias assumption that obvious?	1	0
Unlikely in public sector projects	1	0
Choice of agile or traditional PM approach depends on the project characteristics	1	0
Estimation process sequence should depend on identified constraint	1	1

Table 6 Codes and concepts identified during interview with P1

Parametric tools and methods concept

From the perspective of increasing the level of significance, conceptualization is a very supportive process. The more conceptualized the code becomes, the more references to transcribed text it has. For example, P1 raised the concept of "Parametric tools and methods" three times. It was clear that the expert wanted to portray his views on the accuracy of estimates. He said:

"If there is well-known technology … parameters are unequivocal and scope is unequivocal – we use the norm."

He had in mind that well-defined and predictable chunks of work in a favourable contextual situation could be used as a basis for an estimation process. P1 supported his view on parametric tools by adding dedicated software solutions – those that would speed up the estimation process on the basis of previously defined parameters:

“If we have the opportunity to use a parametric model … we input data and the information system calculates estimates.”

He placed a lot of trust in this approach. In his view, without the availability of parametric tools, the search for a new solution must be initiated.

“When we know that there is high probability of losing the accuracy of estimates and we cannot apply typical parametric tools … then we abandon estimating and we assume a different philosophy of work.”

This phrase “different philosophy” points to methods like agile – more dynamic planning not requiring *a priori* estimation of the majority of the project’s scope. P1 built a concept which shows that parametric approach may be supportive of an increase in the accuracy of estimates. At the same time he mentioned contextual aspects, which in his view, are favourable. This was conditioned by having known technology and scope as well as IT support.

Technically, the “Parametric tools and methods” concept was placed within the conceptual network. As shown in Figure 13, its network density was defined by three dependencies.

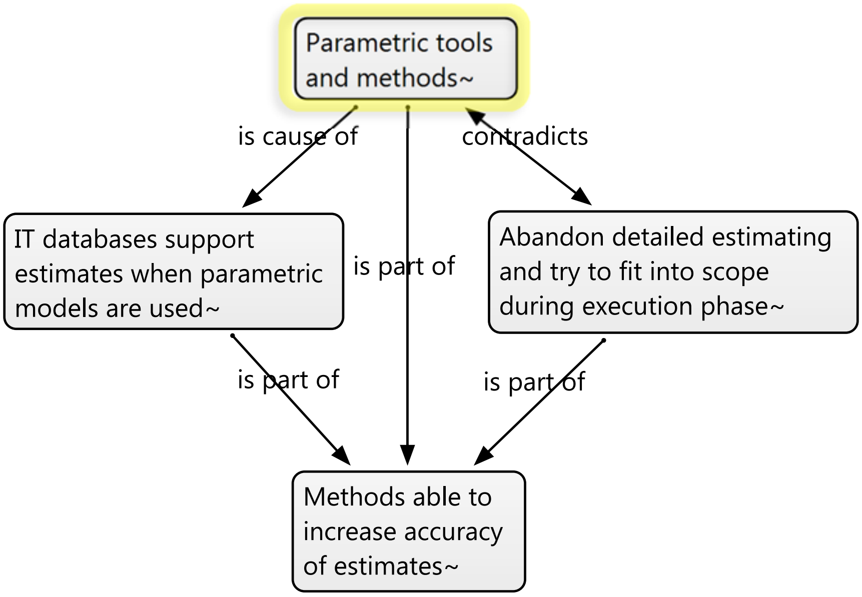

Figure 13 Parametric tools and methods concept

Not every team member is capable of working in PM environment concept

This next concept had a low level network density equal to two dependencies in the conceptual network. However, the interviewee, while discussing competences of team members, reacted quite emotionally. As the concept label indicates, he accepted the possibility that not everyone should be involved in projects.

He expected an individual to be able to develop his or her own PM processes, to fit in with the business context and to stay focused on business – not just the technical goals. This requirements "bar" was raised quite high. P1 said team members:

> *"… should be able to create their own processes, and not only to follow the dictates of methodology,"* and also … *"They should understand business goals and not just the product."*

P1 continued to elaborate on the topic. According to him, the problem is mainly related to the misunderstanding of a technically oriented key performance indicator (KPI) of business goals. For example, in the case described by him, someone could implement an enterprise resource planning (ERP) system on time and within the planned project schedule. Unfortunately, the implemented ERP may still fail to support major business processes. What does this have to do with estimates? It may require an update of the planned schedule and budget in order to meet the business goals. This topic was also raised during the discussion related to lessons learned. There, the expert also questioned making use of KPIs. In his view it could mislead project conclusions and thus bias the KM process.

Methods able to increase accuracy of estimates concept

Due to the importance of the "Methods able to increase accuracy of estimates" concept to the formulation of the framework, it simultaneously became a category. The initial significance level was very low and defined as one, while the density was the highest, achieving fifteen (see defined dependencies depicted in Figure 14). The researcher was pleased that expert P1 so often referred to accuracy of estimates. It allowed the building of an initial conceptual network and a proposal of the first categories.

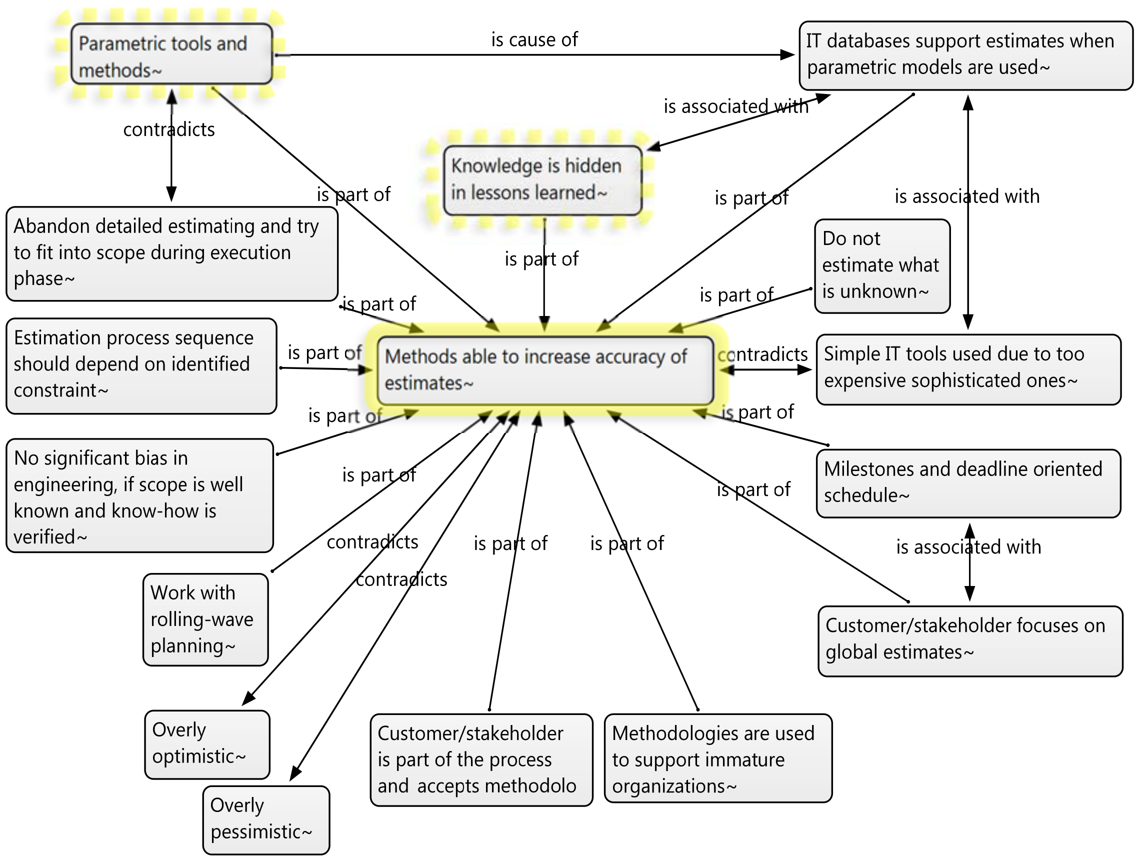

Figure 14 Density of "Methods able to increase accuracy of estimates" concept

It is not possible to discuss here all of the codes. Nevertheless, alongside concepts already introduced, there are important others that should be pointed out, for example: “Projects with scope to be defined during a project life cycle” and “Knowledge is hidden in lessons learned”. Both of these received high density levels.

Categorization of concepts

Axial coding supports the formulation of categories. To define them the researcher developed the initial conceptualization of the data into a more widely perceived phenomena to develop a starting point for the next interview. Section 4.7.5 defines the sequence of work in Atlas.ti and shows that the categories were registered as code families to adapt the functionalities of the software.

In general, discussion with P1 was based around a few major core topics. It was a natural consequence of the conversation development and examples provided by an interviewee. The following points briefly describe the formulated categories:

1. P1 provided his view on the topic of accuracy of estimates and raised this as a vital element of planning and a project’s success. Therefore a category was built on the basis of the concept “Methods able to increase accuracy of estimates”. This category was labelled “C. – Methods able to increase accuracy of estimates”. If this category incorporates further concepts, then it may require additional subcategorization.
2. The expert wondered whether it is always necessary to improve accuracy of estimates. He insisted on adaptive techniques and general adjustment and flexibility allowing avoidance of the problem. The category was formulated around the concept “Projects with scope to be defined during a project life cycle” and labelled “C. – Flexible planning”.
3. P1 referred many times to a potential misunderstanding of the “real” business goals. Expected and subsequently estimated KPIs like time, work effort, budget and defined functionalities of products may mislead and result in losing business focus. Expected KPIs may pull motivation in the wrong direction and destabilize the estimation and planning process. It was decided to define this phenomena as a separate category. P1 frequently referred to the problem:

"If you have been given a KPI ... your success is measured by delivery of that KPI and not by the achievement of a business advantage."

He also promoted the view that slight underestimation may result in increased efficiency and a more ambitious approach:

"Potentially with less safe estimates, you are more motivated to execute these projects more ambitiously. From the corporate, KPI perspective it would not result in success, but from business perspective, it would be a better-accomplished project."

This category was defined around the concept of "Focus on business goal and not on a product goal" and labelled "C. – Losing business focus".

4. P1 referred to KM, and in his view this was closely related to KPIs and the "C. – Losing business focus" category. Having taken into account the emphasis on KM provided by the literature chapter and the input of P1, a decision was made to define this problem as a separate category. However, it should be underlined that, given the inductive approach, an expert triggered this decision. The category was built around the concept "Knowledge is hidden in lessons learned" and named in simplified form "C. – Role of lessons learned in KM".
5. The expert commented on the importance played by the role of the team and he introduced the concept "Not every team member is capable of working in PM environment". Consequently, the related category was formulated and labelled "C. – Expected personal profile". It contains all concepts which refer to personal characteristics. P1 was quite harsh in his unequivocal statements:

   "... shall not try to manage projects – this is an organizational mistake. In order to manage projects, a person who understands business goals, should take responsibility."

   Importance of PM competences was clearly raised and should be further conceptualised in the following inductive iterations.

6. In his examples, P1 often addressed different business contextual situations, mentioning concepts like “Consulting services sector projects”, “IT and service sector projects”, “Engineering, construction industry projects” and “Public and education sector projects”. Thus, logically, the category was formulated and labelled “C. – PM environment context”. It should be mentioned that “Public and education sector projects” was not discussed in very much detail.

Table 7 recaps the categorized concepts. This process was executed in Atlas.ti by making use of the code families. It should be noted that some concepts were shared between categories. It is a sign of the existence of logical connections in the transcript and thus an entry point for further clarification in the axial coding process. Additionally, an increase in saturation achieved through the following data inputs and the additional inductive iterations should decrease the number of concepts that are shared between categories.

Categories	Codes and concepts
C. – Methods able to increase accuracy of estimates	Customer/stakeholder focuses on global estimates
	Customer/stakeholder is part of the process and accepts methodology
	Do not estimate what is unknown
	Estimation process sequence should depend on identified constraint
	IT databases support estimates when parametric models are used
	Knowledge is hidden in lessons learned
	Methodologies are used to support immature organizations
	Methods able to increase accuracy of estimates
	Milestones and deadline oriented schedule
	No significant bias in engineering, if scope is well known and know-how is verified
	Parametric tools and methods
C. – Flexible planning	Abandon detailed estimating and try to fit into scope during execution phase
	Consulting service projects
	Customer/stakeholder is part of the process and accepts methodology
	Do not estimate what is unknown
	IT and service sector projects
	Projects with scope to be defined during a project life cycle

	Work with rolling-wave planning
C. – Losing business focus	Focus on business goal and not on a product goal
	Focus on lessons learned KPIs and not on business goals
	KPIs should be removed from lessons learned
C. – Role of lessons learned in KM	Experience as a risk
	Experienced have tendency to overestimate
	Knowledge is hidden in lessons learned
	Lack of technical know-how
	Misunderstood or wrong know-how
	No significant bias in engineering, if scope is well known and know-how is verified
	Insufficient knowledge of scope of activity
	PM certification is a business product for sale
	Too much experienced and managing mistakes
C. – Expected personal profile	Age and experience
	Overly optimistic
	Overly pessimistic
	Not every team member is capable of working in PM environment
C. – PM environment context	Consulting service projects
	Engineering, construction industry projects
	IT and service sector projects
	Public and education sector projects

Table 7 Categories with assigned codes and concepts

5.2.4 Axial coding and found dependencies between categories

The coding process cannot be narrowed down to assigning labels to the transcribed text or even to conceptualizing codes into concepts. Even though Atlas.ti was designed to support the conceptualization process, qualitative analysis cannot be treated as the quantitative view of how often some text or concept was identified. The coding process is not only about labelling categories "but also how to dimensionalise them and discover their conditions, consequences, and associated interactions and strategies" (Strauss 1987, p.154). These aspects, perceived in PM contextually and with their distinctive features of coding, strive toward the building of a framework.

To support reflections on axial coding, all codes and concepts were mapped and linked to a conceptual network initiated in Figure 14 and depicted in Figure 15. It is immediately visible that due to the high density (number of dependencies) “Methods able to increase accuracy of estimates” became a central concept.

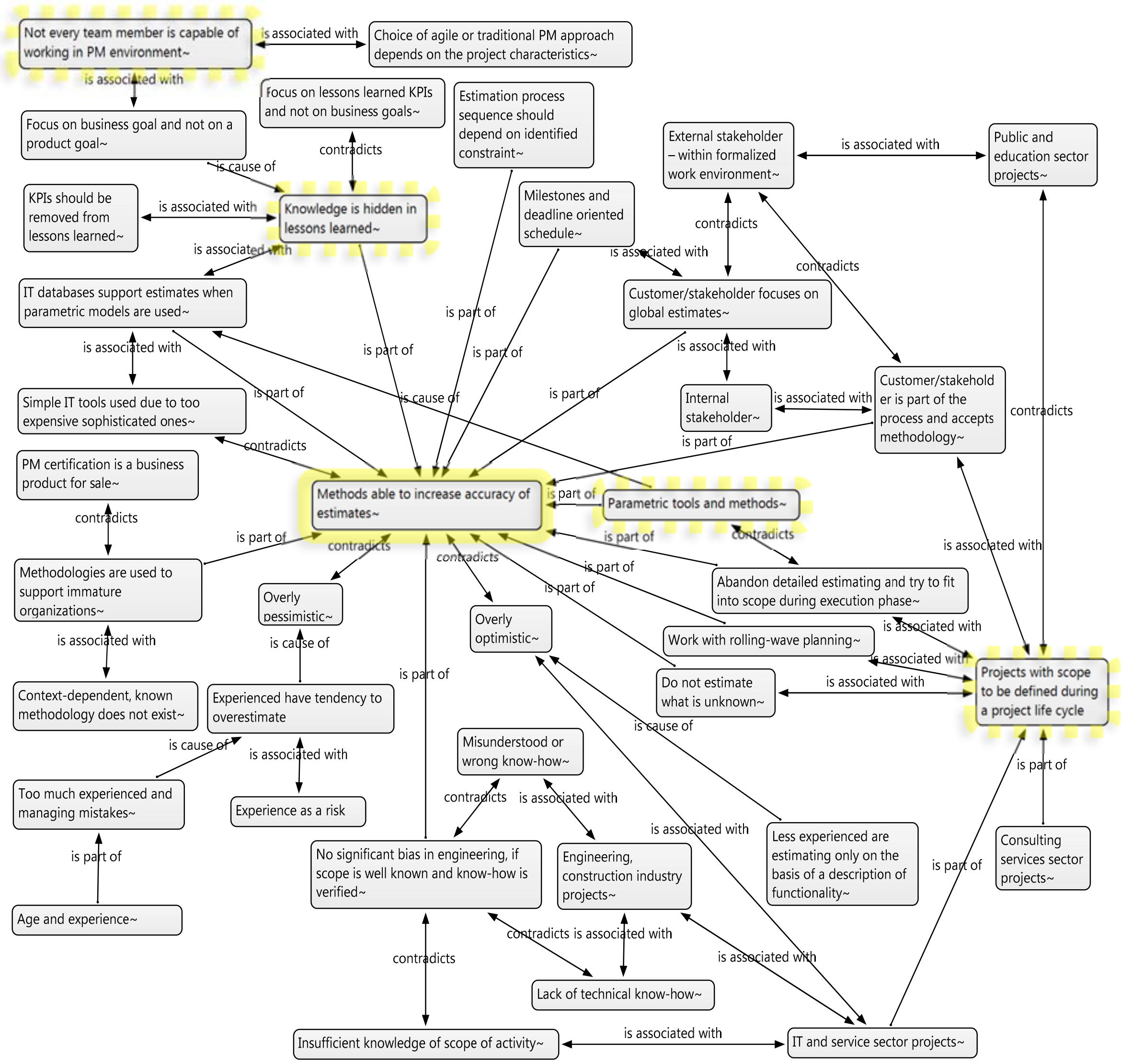

Figure 15 Conceptual network after interview with P1

“C. – Methods able to increase accuracy of estimates” in relationship to “C. – Flexible planning”

This major category was widely supported with PM context-dependent tools. According to P1, parametric tools and methods should be used in what is generally perceived to be the industrial sector and supported by related databases – ones which contain measured data. At the same time, and in his view, this is not a characteristic of the “C. – Flexible planning” category. “Flexible planning” focuses instead on abandoning the whole schedule estimating and tries to manage the known scope.

However, as listed in Table 7, the two categories discussed share the same concepts. They do recognize the contextual need to have a customer/stakeholder as part of the process, and they both expect him to accept the methodology. Also, they are similar in assuming that what is unknown should not be estimated. However, “unknown” has a different meaning in these two categories. It may indicate lack of knowledge in defining scope or may describe something being intentionally put beyond the planning horizon. Thus, while paying attention to other relationships, these categories are considered as associated but not contradictory.

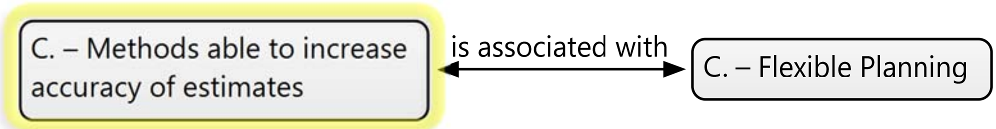

Figure 16 The start of axial coding – networking process

“C. – Losing business focus” and “C. – Role of lessons learned in KM”

P1 frequently indicated a relationship between these two categories and the accuracy of estimates. He believed that, if present, KPIs should be removed from lessons learned since:

“KPIs may pull motivation in the direction not related to the business goals.”

He considered evaluating success in overestimated or underestimated projects. Budget and scheduled KPIs, compared with planned and executed values, could bias lessons learned and shift the focus mainly to product goals. From a critical point of view, it could be said that everything depends on choosing a correct set of KPIs – one that corresponds to business goals. P1 chose a different path. He preferred not to risk losing focus on business goals and lessons learned. He explicitly supported his view by saying:

“For me, the lessons learned do not form a tool dedicated to the measurement of KPIs.”

In conclusion, both categories remain associated. Additionally, “C. – Role of lessons learned in KM” covers topics related to lessons learned but also refers to the IT repositories of collected data – databases. The category discussed also considers PM certification, technical know-how, too much experience and knowledge of scope. Many of these ideas are conceptually linked to the “Methods able to increase accuracy of estimates” concept. Therefore, “C. – Role of lessons learned in KM” was linked to the “C. – Methods able to increase accuracy of estimates” category.

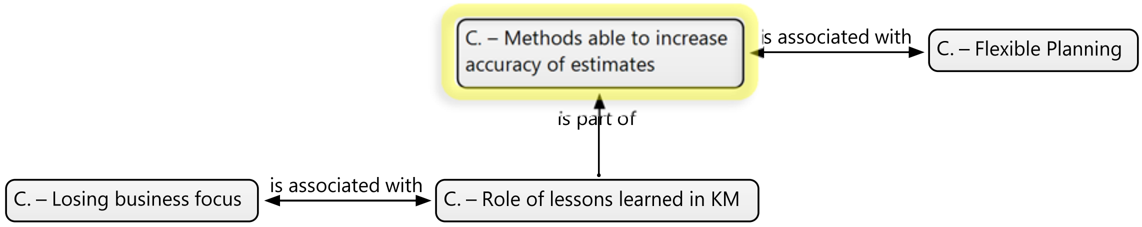

Figure 17 Axial coding developed around “C. – Methods able to increase accuracy of estimates” category

“C. – Expected personal profile”

This category, in the view of P1, remained related to “C. – Role of lessons learned in KM” through experience and the general set of competences. The expert even believed that some people should not become part of a project team. In their behavioural traits he also addressed being overly optimistic and pessimistic. P1 also referred to a team member’s ability to develop individual processes in order to be able to respond to a specific contextual situation. Alongside raising this dependency, he built a clear relationship with the “C. – Losing business focus” category. Despite being discussed – mainly informally – after the interview, this observation supports the idea that there are teams focusing mainly on project deliverables and thus losing the wider business focus. It may result in a need to update the schedule and effectively change previous estimates.

"C. – PM environment context"

P1 referred to four business sectors and concepts contained within the category above. This was a satisfactory situation although the public and education sector was covered in little detail. The "C. – PM environment context" category was not linked to any other since it would be necessary to relate it to all of them. This category is preferably treated as a contextual background allowing a deeper discussion on which method of improving accuracy of estimates may be applied and under what contextual conditions. The value of such a framework could be supported by the coding of P1's in vivo statement:

"Context-dependent, known methodology does not exist."

Figure 18 summarizes and describes the current perception of the phenomenon, observed at category level. This network will subsequently be verified in the next expert discussion.

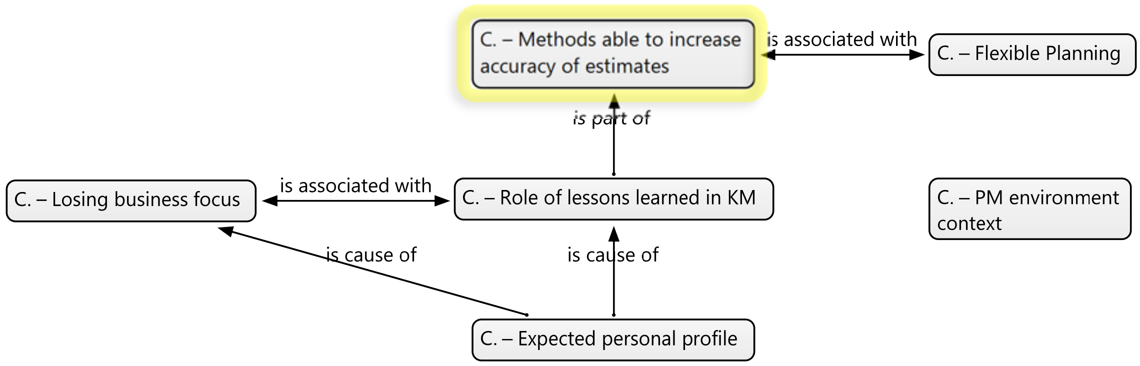

Figure 18 Dependencies between categories identified during interview with P1

Reflections and critical view

Conclusions derived from the current axial perspective were somewhat limited. Nevertheless, the expert interview should be considered as a reliable starting point. Many of the findings contradicted the view of the researcher, effecting some surprise (Schön 1991, p.56). It was difficult to maintain self-control and not to challenge the opinions of P1. However, in respect of ethical standards, an unbiased approach was maintained.

5.2.5 Conclusion

Reflection on findings

During the conversation with P1, there were instances of surprising comment or insight which stuck in the mind of the researcher. The list below contains the information captured, regardless of whether something was adding to the science or simply attracted attention. This sort of brief summary helps to keep track of the evolution of the view of the problem, and also helps to dynamically moderate issues raised in subsequent interviews.

1. A team member and project manager should know when to abandon detailed estimating.
2. Do not estimate what is unknown.
3. Context-driven methodologies do not currently exist.
4. Experience may be considered as a risk, leading to overestimation.
5. Maintain a focus on business goals rather than just on project deliverables.
6. Some methods are unlikely to be applicable to the public and education sector.
7. KPIs should be removed from lessons learned.
8. PM certification is a saleable business product.
9. Simple IT tools are in use due to the high costs of more sophisticated ones.

Interview/case categories covered and further actions

P1 represented an expert category and concentrated on the industrial and service sectors, as well as internal and external projects. He also referred often to dynamic/agile PM approaches. One context which seemed to require additional support was defined as the public and education sector. The decision was made to dedicate the third intensive interview to public sector projects, if possible. At the same time, it seemed that the methods contained in a traditional PM approach should be analysed more intensively. For example, the expert only indirectly addressed the topics of change and RM. P1 considered PMMs as sets of tools in which team members and project managers needed to know what, and what not, to apply and when to apply them, with project context being the deciding factor.

Even though it had not been classified as an interview/case category, it was felt that the international project environment should also be analysed. According to the transcript, audio recording and collected observations, P1 did not directly refer to such projects and it seemed it would be valuable to check whether his views were valid for international ventures. The decision was made to identify an interviewee that had a strong background in international PM.

In order not to lose focus, the same set of initial questions was used in the next interview. The next respondent was also an expert and thus testing the axial coding results could either contradict or increase the trustworthiness of the present findings, with potential updates being made at the level of either the conceptual network or the category dependencies identified in the axial coding process.

In general, the strategy that was designed works, although critical reflections and improvements can be identified, mainly in relation to Atlas.ti functionalities, and these are described in a dedicated section. The transcription process appeared to be the most time-consuming aspect but – by virtue of the automatic synchronization with data sources provided by Atlas.ti – it enabled subsequent traceability.

5.3 Expert M1's experience

5.3.1 Choice of the next respondent

Limitations of P1 insight revisited

The interview with expert P1 revealed a lack of information in the area of the "C. – PM environment context" category. The public and education sector required additional analysis, especially when compared to the amount of information that P1 shared in relation to IT-related agile approaches as well as on the industrial sector. A lack of reference to international projects was also apparent.

Professional profile

The second expert, M1, had more than twenty years of experience related to PM. He is known internationally in the PM business sector and it was considered an interesting opportunity to interview him. M1 is also a notable member of an internationally recognized PM organization. He possesses experience in PM consulting, managing projects and organizations, and is also frequently invited to speak at PM conferences.

The interview with M1 had the potential to cover all interview/case categories including the public sector, and even to address aspects of international projects. The position held by M1 and his experience in the field suggested that this could be an opportunity to verify the views of P1.

5.3.2 Data collection

Place, time and tools

Discussion was divided into two sessions due to the respondent's limited availability. Video-recorded interview took place in an office. The language of the conversation was English. A summary of the substantive parts of both sessions was forty-five minutes long. At the same time as the video recording, the researcher made appropriate notes.

Process of interviewing

Respondent M1 was quite convincing in his view on the problem of accuracy of estimates. However, he totally omitted agile approaches. Nonetheless, the researcher does not consider this to be disadvantageous since this topic was covered earlier. M1 preferred to deliver a more holistic view on the accuracy of estimates. What was very characteristic of the respondent's style is that he backed his comments with various cases and examples. From the perspective of the research project, such an approach increases the trustworthiness of findings.

In this semi-structured interview, the expert was addressed with initial questions (numbers one, two, three and five) from Table 4. Question number six was reformulated into a more general inquiry regarding the relationship between the PM environment context and the expected bias in the estimation process. The final part of the discussion was dedicated to the role played by stakeholders. After the interview that was conducted with P1, concepts considering stakeholders still remained unclassified as to their category. This issue required additional clarification.

5.3.3 Data analysis

Transcription

As in the case of P1, the M1 transcription process and open coding were also merged together. The transcript was prepared in the English language. Transcription of the video-recorded material has proven that such data may be more "dense". Body language, expression, activity, non-verbal information were much easier to pick up. It allowed the researcher to think more effectively of this what was said.

Identified codes

The most important issue, and actually a new problem, was related to the consistency with earlier analysed data – that is to say, the input provided by P1. The entry conceptualization of the M1 interview resulted in generating new, but sometimes not always necessary, codes. The researcher was quite often forced to reanalyse the list of new codes and concepts in order to decrease its size. This was done by browsing through detailed descriptions of the P1 codes. This policy helped to more effectively improve significance of the already identified codes. Helpful in dealing with the problem were categories identified earlier. Axial coding proved here its positive impact on efficiency.

Coding went through the iterative process. Unlike the interview with P1, additional iterations have been undertaken to those, requiring further investigation into parts of the collected data. This transpired especially when of discussing stakeholders' roles. Due to the application of the strict policy toward the coding process only a few new codes were identified. After interviewing M1, the list of codes consisted of forty-six. The new codes are listed in Table 8.

Codes and concepts	**Sig**	**Den**
Access to information and history	8	1
Frustration	1	2
Questioning expert's estimate results in a loss of morale	2	1
Outside parameters that cannot be controlled	1	1
Successful projects regarded as an example of accurate estimating	1	1

Table 8 Codes and concepts identified during interview with M1

Access to information and history concept

This was a very new concept provided by M1 and at the same time had a high (measured as eight) significance level. The respondent expected this requirement to be fulfilled regardless of the project contextual situation. Information of how something was estimated and the history of records, deviations from previous projects. According to M1, regardless of whether the project is in the IT, industrial or public sectors, or whether it is an external or internal project, this prerequisite must be fulfilled. He said:

"If we could get information and understand how it was estimated, then we would have far more information and that would be very helpful. It is connected with knowledge management and information from other projects – it would help."

From time to time similar thinking was visible within examples:

"Monday's quality of welding is different to Friday's. It depends on temperature, on sunshine and many other factors that you would normally take into account."

M1 requires having access to information and even to conferences and scientific journals. In fact, in the majority of the provided cases he often returns to this issue, strengthening and broadening, in consequence, the "C. – Role of lessons learned in KM" category.

Age and experience concept

Although this code was identified during the interview with P1, its actual conceptualization was mainly supported by M1. The respondent referred to this concept in many of the cases:

> *"Finally, we are in a position where those experienced professionals have enough experience to give estimations."*

And sometimes even more controversially:

> *"The brain of a young person develops in such a way that the area responsible for taking risk is not fully developed until, let's say, around twenty-five."*

The respondent perceives young age as a factor supporting an underestimating tendency. M1 sometimes referred to this tendency as a willingness for more of a challenge, more fun and more risk. However, he did not recognize the problem of being over-experienced. P1 did. Expert M1 considered increasing the level of experience only from an advantageous side:

> *"If someone is very experienced, I believe they will tend to get more precise estimations."*

Frustration code

This code appeared for the very first time and achieved low significance level of one. Nevertheless, it refers to the so called pessimistic experience. The respondent provided a description of the case where estimates given by experts were intentionally decreased. Surprisingly, overestimation did not pop-up. Contrary to this, experts still offered acceptable estimates in subsequent projects:

> *"The reaction was frustration. It needed to be worked through but it did not require double or extra overestimation."*

Again this view provided more insight into what the expected personal profile should be. It is not only about technical knowledge, experience – it is also about the interaction between different needs and expectations. Especially those imposed by influential stakeholders.

Categorization and subcategorization of concepts

New codes were effectively assigned to already existing categories. This allocation is in each individual case verified between the P1 and M1 transcripts. The defined categories were already sufficient to cover newly identified codes and concepts. However, due to the increased complexity, new subcategories were identified. This issue is discussed in the next sections.

Codes and concepts	**Categories**
Access to information and history	C. – Role of lessons learned in KM
Frustration	C. – Expected personal profile
Questioning expert's estimate results in a loss of morale	C. – Expected personal profile
Outside parameters that cannot be controlled	C. – PM environment context
Successful projects regarded as an example of accurate estimating	C. – Role of lessons learned in KM

Table 9 Codes and concepts subordinated to categories

During the interview the researcher attempted to deepen the understanding of the earlier defined "C. – PM environment context" category. It was expected to get more understanding of public sector. The researcher asked respondent the following:

"Do you think that there are some industrial areas or business areas where it is more likely to find bias in estimates or some areas where bias is small?"

The expert replied typically following his rather holistic point of view. He avoided focussing on any specific area but instead he again supported the "Age and experience" concept:

“Let’s say biochemistry … is being developed right now. Today’s biases and margins will be large but later on they will surely be reduced because the level of experience in the industry will improve.”

Unfortunately, this and other related statements do not provide more insight into business sectors. M1 used here two major cases – one related to industry and another to IT. He concentrated on commonalities and not on contextual differences. His view, however indicated that there are common characteristics to all business sectors. Ones which should become more mature as time goes by. That is to say, should become able to yield more accurate estimates.

After finishing the analysis of respondent P1, a few codes related to stakeholders remained uncategorized. To shed more light on their role and link it to the conceptualised framework, an additional question was formulated. M1 referred to one by describing a case and giving a few examples. According to him, stakeholder should stay close to the team to be able to share information:

“For sure, getting them to work as a team is an absolute priority ... they must share – share good information that will help us to get better estimates.”

It was interesting that M1 came up with a public project case. He presented the practices of an external stakeholder which resulted in a decreased accuracy of estimates. It was an example of an intentional withholding of information which should have been accessible to a project team. It has shown that together with the team members and project managers (P1’s perception of a problem) also profile of stakeholders should be taken into account. Consequently, the “C. – Expected personal profile” category was divided into two subcategories:

1. “C. – Exp., Subcat. – External and internal stakeholders”
2. “C. – Exp., Subcat. – Team members and project managers”

Logically, following this decision and paying attention to current findings the "C. – PM environment context" category was supported by the following subcategories:

1. "C. – PM., Subcat. – IT and service sector"
2. "C. – PM., Subcat. – Industrial sector"
3. "C. – PM., Subcat. – Public and education sector"

Listed subcategories correspond to the cases and examples provided by both experts, P1 and M1.

5.3.4 Axial coding, new relationships and shift in dependencies

The identified codes were assigned to categories and located in the network of dependencies. Minor improvements are discussed later especially in the types of relationships. A major update was to the conceptual network and was related to the new codes added.

Minor changes

"Age and experience" code was unlinked from "Too much experienced and managing mistakes" and linked to "Knowledge is hidden in lessons learned". M1 did not perceive experience as something dangerous to the accuracy of estimates. Therefore, earlier unconditioned dependency could be considered as a mistake. New dependency enriches the view of what exactly the lessons learned are. P1 considered this as a sort of summary also contained in some database. M1 considers collected knowledge mainly as a characteristic of the person. He often referred with the use of examples to "Age and experience" and how it should be in his view perceived. Change is also more correct from the point of view of axial coding. It strengthens the relationship between the "C. – Expected personal profile" and "C. – Role of lessons learned in KM" categories.

Major update

As indicated in Figure 19 the new concept “Access to information and history” was linked to “Knowledge is hidden in lessons learned”. “Outside parameters that cannot be controlled” was linked as contradictory to “Methods able to increase accuracy of estimates”. The new code “Questioning expert's estimate results in a loss of morale” was connected to a new code “Frustration”. “Frustration” was associated with “Methods able to increase accuracy of estimates”. It may be surprising that here contradictory dependency was not set. M1 in his examples, showed that cutting an expert’s estimate would not necessarily lead to pessimism and overestimation. According to him, experts may still estimate correctly despite being frustrated.

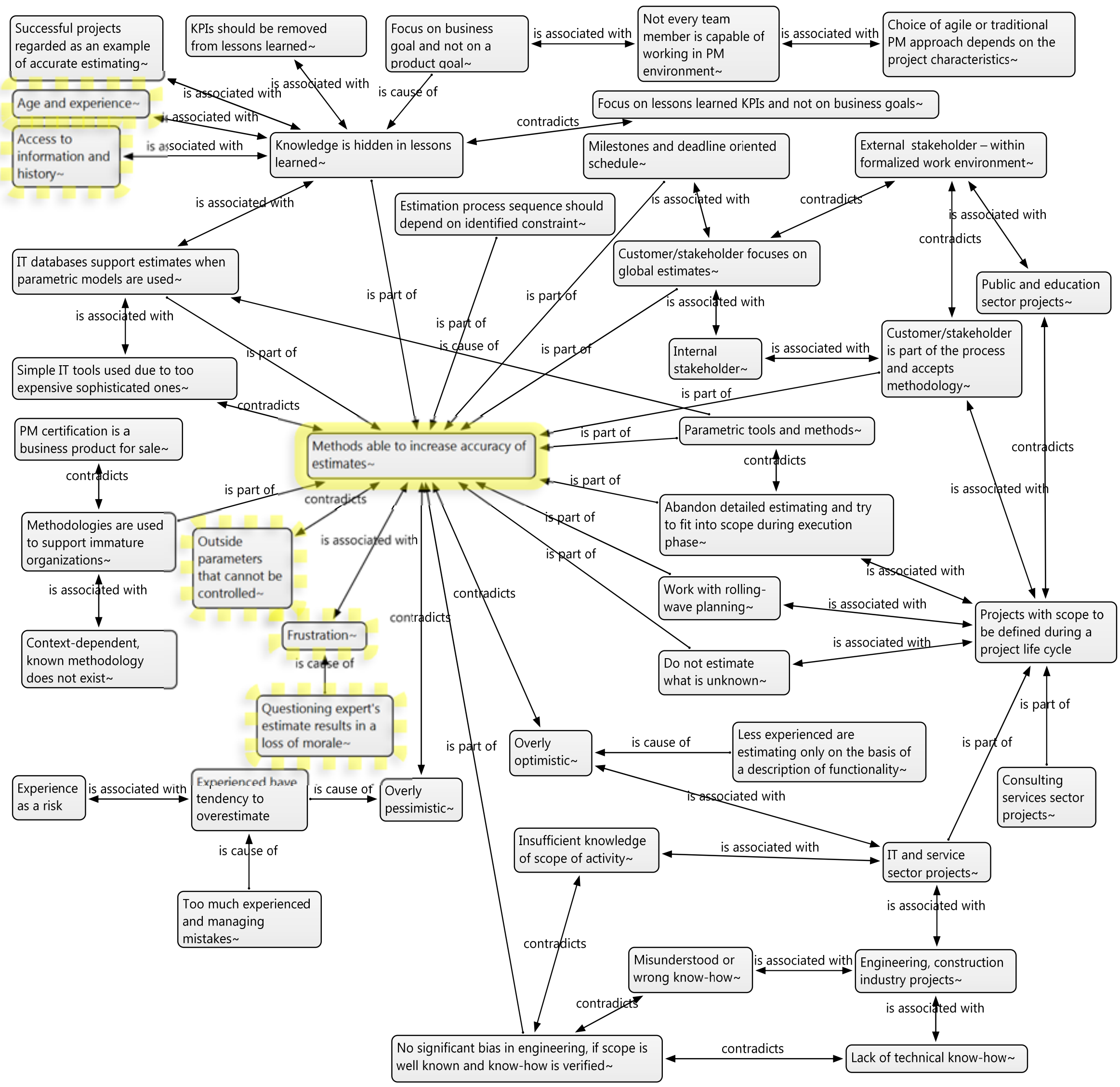

Figure 19 Conceptual network updated after interview with M1

From the point of view of looking for patterns and dependencies between categories, M1 developed and broadened the current viewpoint. M1 also helped to identify subcategories and provided cases to reaffirm its definition. As Figure 20 depicts, he provided more details at the axial coding level.

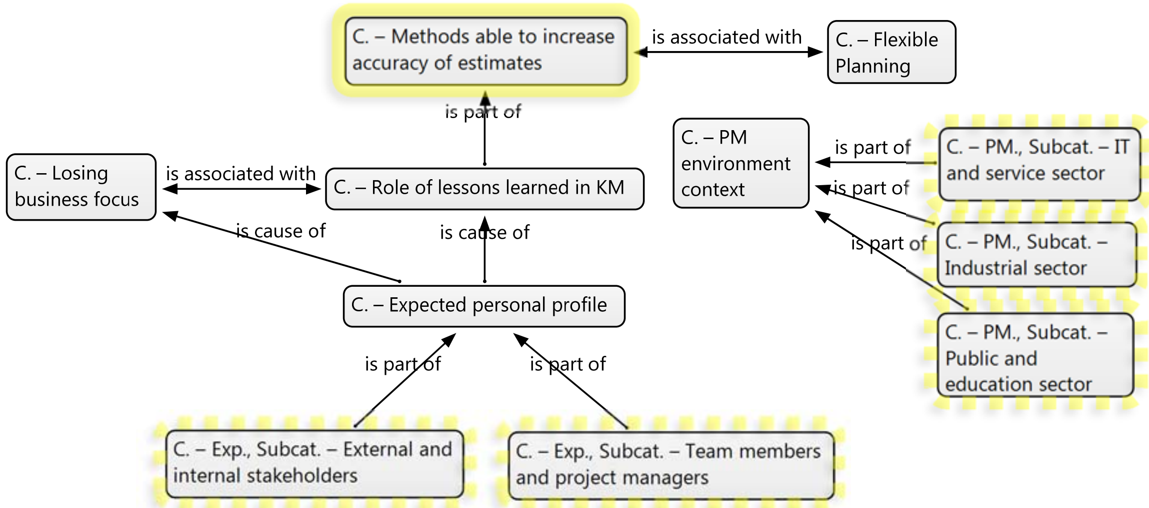

Figure 20 Dependencies between categories and subcategories updated after interview with M1

Reflections and critical view

Subcategories seemed not always to be self-evident. Some concepts clearly belong to this or another subcategory. However, there are situations where concepts seem to match more than one subcategory. These nuances may potentially only to be effectively discussed at the transcripts level. There, the context of specific citations enriches interpretation and clarifies the problem.

The "C. – PM environment context" category started to develop description of various contextual situations. Thus, it is now expected that, depending on analysed cases, new potential subcategories may occur. It is possible that this particular category will be especially helpful to the discussion of the framework.

5.3.5 Conclusion

Reflection on findings

Expert M1 had his own interesting characteristic, which was visible in the support given to many concepts and also in the increase in the significance levels afforded to some of them. The list below contains the captured information that attracted most attention; it does not represent a formal classification. Nevertheless, it helps to keep track of the thought processes.

1. Through combining the views of experts P1 and M1, it could be concluded that experience is crucial to the accuracy of estimates, suggesting three principal levels of experience:
    a. Under-experienced with a tendency to underestimate.
    b. Appropriately experienced and able to deliver accurate estimates.
    c. Over-experienced and veering toward overestimation.
2. Questioning an expert's estimates may result in frustration and a loss of morale.
3. Regardless of the results of pessimistic experience as presented by Goldratt (1997), frustration may appear and may not lead to overestimation. Other factors related to a stakeholder's role and expert position may moderate reactions during the estimation process.
4. In successful projects, someone may incorrectly conclude that they must have estimated well.
5. There are external parameters that influence estimates and which one cannot control, for example, the weather.
6. The age of a person is influential in the estimation process.
7. Stakeholders have to share information with project managers and project team members.

Interview/case categories covered and further actions

The researcher expected to hear more on international and public sector projects. Although M1 partially covered these issues, he mainly concentrated on industrial and IT project cases. He also omitted case categories relating to internal projects and dynamic/agile PM approaches. Fortunately, both of these aspects had been previously elaborated upon by P1.

This outcome provided support to the decision to dedicate the next interview to a person representing experience in international and public sector projects. To constrain the investigation, the person should be a practitioner rather than another expert, and it was planned to initially follow the same proven list of questions.

5.4 Public sector practitioner S3

5.4.1 Choice of the next interviewee

Practitioner S3 as representative of public sector

After having analysed the input of the two experts, some contextual gaps still remained and, therefore, the researcher decided to focus on public sector and international projects. The next person interviewed worked only on publicly financed projects. S3 is an employee of an embassy and acts as a programme manager. He manages international projects financed by a European country and works in a multi-project oriented environment. At any one time, he carries responsibility for around twenty simultaneous projects.

5.4.2 Data collection

Place, time and tools

Opportunity to conduct an interview was identified during a business coaching session. His willingness to participate was spontaneous. S3 agreed to dedicate time in a lunch break to an interview. Video-recorded interview was organized in a conference room. Both sides spoke Polish during discussion. The interview was around forty-five minutes long.

Process of interviewing

Introductory part on interviewing was committed to the understanding of contextual aspects of a public sector and therefore the initial questions formed the basis of a very interactive discussion. The researcher initiated this process with questions numbers one and five. This situation did not devalue the interview. Subsequent discussion in more unstructured form allowed to better understand contextual aspects of a public sector. S3 quite often underlined:

"This is our characteristic, our specificity."

In comparison to the previous experts' interviews, with S3 it was sometimes more complicated to follow his understanding of PM-related tools and techniques. The previous experts defined their view in very clear terms. They also offered already generalized conclusions at the same time supported by many cases. In contrast to this, S3 often required additional supporting questions to help him better explain his thoughts. This carried the risk of possibly affecting the quality of the output of this particular interview. To mitigate this risk it was decided to find for another interviewee representing the public sector.

5.4.3 Data analysis

Transcription

Transcription was carried out in the mother tongue of the interviewee. Video-recorded material supported a detailed analysis. Parts of the text used for quotations were translated into English. Due to the occasional unclear expression it was necessary to omit some small parts of the file. This policy was applied to avoid the risk of potential bias. In these instances, the researcher could not guess what was said.

Identified codes

Coding process introduced four new codes but at the same time improved the significance level of many others. New codes were introduced to the conceptual network and became linked mainly to the “Public and education sector projects” concept. Thus its density achieved a six in Table 10 below. After having interviewed S3, the list of codes contained fifty elements. Its small increase proves that coding served mainly to increase the level of significance. The most increased, as well as the new ones, were listed in 10.

Codes and concepts	**Sig**	**Den**
Public and education sector projects	10	6
Methodologies are used to support immature organizations	7	3
Simple IT tools used due to too expensive sophisticated ones	4	2
Duality in decision-making process	1	1
Elections and change of sponsor	1	1
Elections at a local level	1	1
Imposed and unverified deadlines	1	1

Table 10 Concepts most increased in significance and new codes identified during interview with S3

The significance level of the “Public and education sector projects” concept increased from two to ten, after the interview with S3. It became clear just how contextually different the public sector is to the industrial or IT sectors. Also defined by P1 – “Methodologies are used to support immature organizations” increased its significance level from one to seven. Similarly when it refers to IT tools its level increased from one to four. New observations supported development of axial coding process what is presented later in dedicated section.

Duality in decision-making process concept

Publicly financed international projects may have an unclear leadership. Stakeholders may consider themselves to work more independently of each other, which, without coordination, may result in jeopardising deadlines. S3 while thinking of an exemplary project case said:

"We could say that evaluation takes up to three months on the Polish side and up to three months on the sponsor's side."

This "up to" defines the level of uncertainty very well. It also raises concerns about unclear leadership in the public sector. In his examples, S3 provided a lot of stakeholders' demands but only a few stakeholders' participations.

Elections and change of sponsor code

According to the interviewee, politics is not without influence on the accuracy of estimates. This problem cannot be avoided since the respondent is responsible for publicly financed projects. S3 considers these aspects to be difficult to foresee. When thinking of elections he said:

"They also have influence because they may postpone. Due, for example, to the changes in administration, or government."

This postponement implies crossing earlier estimated project deadlines.

Elections at a local level code

Local elections may shift the need to continue with a project. New local administrations may have different expectations. The respondent recognized this as a risk to bias previous estimates. This risk is typically characteristic of the public sector. However, this view was discussed rather indirectly. He provided his opinion in the following way:

"With new authorities and when a project is in the evaluation phase ... there is the risk that perception of the project may change and that it may not be further supported. Priorities may change."

Imposed and unverified deadlines concept

Respondent S3 has shown a mechanism which actually may bring the estimation process to an end. According to him:

"Deadlines are the most often imposed. It could be said that some phases last three months."

It means that under such a circumstances, the estimation process was not used. It seems that with such a "roulette" both overestimation and underestimation situations are possible. It may be dependent on the project case. After discussion with S3 it was possible to assume that an administration and ministries are less sensitive to good PM practices, especially while thinking of maintaining communication.

Methodologies are used to support immature organizations concept

The respondent supported an earlier view that PMMs may be useful in immature organizations. S3 often complained of ministries and his own office, of lacking sound standards. He said:

"I afraid that it is a consequence of having no systems, standards or procedures. We have some simplified procedures, tables."

The respondent referred back to this issue again and again, even without prompting. In his work he does not make use of the best PM practices or PMMs. He expects that if PMM is used it should be accepted by a customer. In his view, a failure to do this would make it difficult to improve the accuracy of estimates. He followed:

"Without support of methodology it is ambiguous. You may cooperate with an enterprise which estimates correctly. But you may also cooperate with one which estimates differently. Why? Because it is a different entity."

The interviewee even tried to refer to or ask for individual tools and methods. It looked as if he was impatient and wanting to apply any PMM techniques. He said:

“To know what subcritical paths look like. To be at least aware that they exist.”

Expert P1 helped to define the code representing this problem – “Methodologies are used to support immature organizations”. S3, confirmed his view that traditional methodology may be supportive in some organizations – for example within the immature PM organizational culture and, in his case, in the public sector.

Categorization of concepts

As in the case of M1 it was not necessary to define new categories. Double checking against previous transcripts assured the possibility of clustering codes and concepts into already defined groups. However, it was still possible to define new subcategories. Table 11 depicts the current number of codes associated to each category. The highest number is related to the “C. – PM environment context” category. The researcher was pleased with this situation as the above mentioned category is directly improving the understanding of contextual factors, dimensioning the whole model of improving estimation process.

Categories	**Number of Codes**
C. – PM environment context	13
C. – Methods able to increase accuracy of estimates	12
C. – Role of lessons learned in KM	11
C. – Expected personal profile	10
C. – Flexible planning	7
C. – Losing business focus	4

Table 11 Categories and number of subordinated codes

To better present the problem related to immature organizations a new subcategory was defined and named “C. – Me., Subcat. – Use of traditional PM methodology”. This subcategory is presented in Section 5.4.4.

Surprisingly, S3 also frequently addressed IT solutions and in general the lack of technical support. He compared his public sector PM work environment to the private one and often complained of not implemented but required solutions:

"I am afraid that this is a consequence of not adopting and customizing systems," and explained … *"Certainly in my case I would expect to be supported by software, tools and data. With my minimum input I could save my work effort and not to work step by step."*

S3 related this problem to the public sector in the following way:

"I tried to plan with the use of word documents where I indicated phases and who works and when. It functions sometimes well sometimes not so well. I am still convinced that the public sector lacks a systematic approach to planning."

Yet, planning, according to PMI (2013), is directly linked to the estimating process. The above-given evidence and the compatibility between S3 and expert P1 persuaded the researcher to dedicate to this issue a new subcategory. It was named "C. – Me., Subcat. – Software and database support". Linkage of this subcategory to the other ones is provided in the axial coding section.

5.4.4 Axial coding and new relationships

New introduced codes were linked to the network as presented in Figure 21, following the logic of what was said in the transcript. Therefore, new relationships were built around "Public and education sector projects" concept. The interview with S3 slightly updated the current network. It was not necessary to shift the previously defined dependencies. However, their correctness was verified against the logic provided by S3.

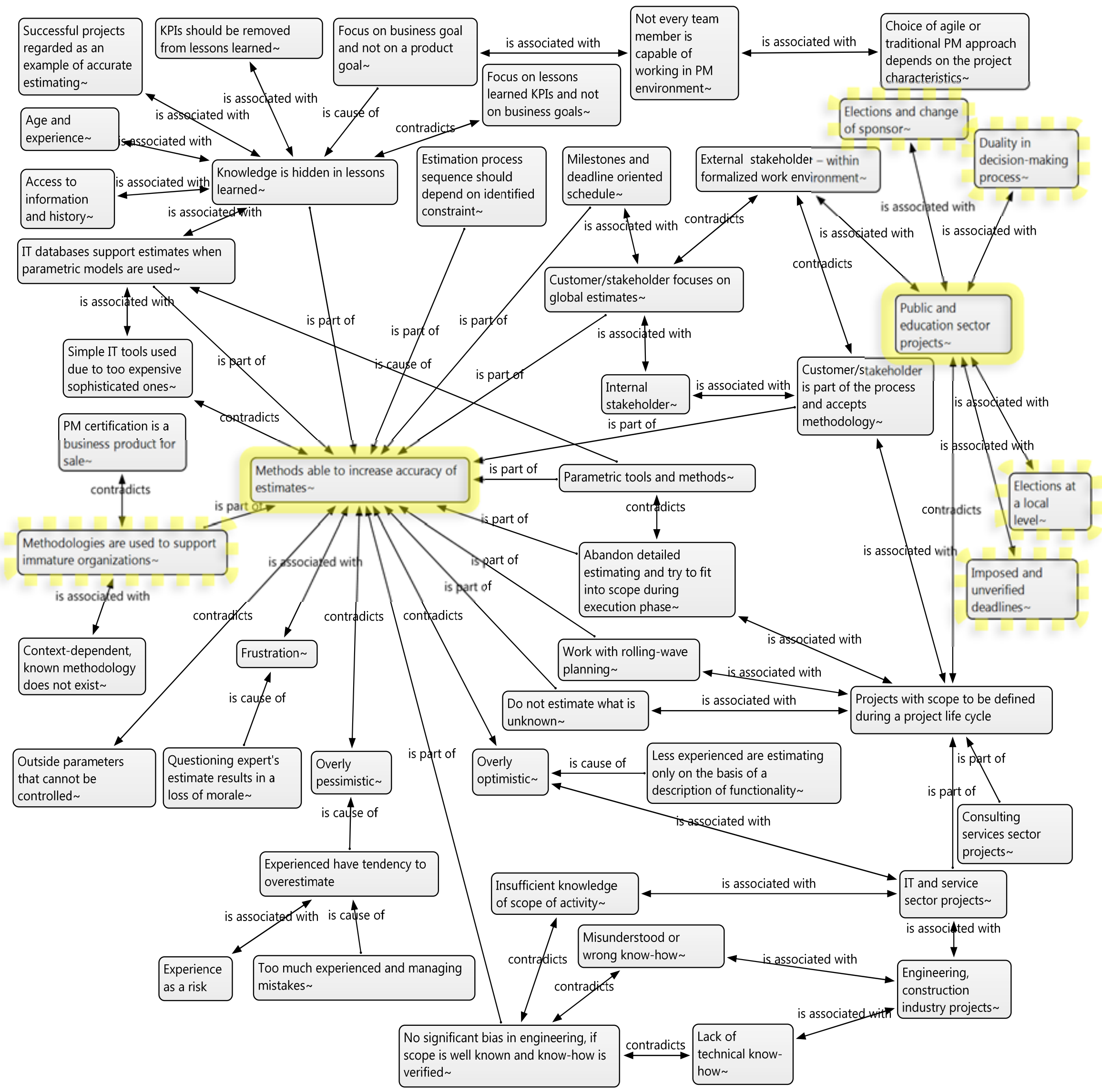

Figure 21 Conceptual network updated after interview with S3

Figure 22 depicts the view of related categories and subcategories. The interview with S3 allowed the identification of the two new and already presented subcategories: “C. – Me., Subcat. – Use of traditional PM methodology” and “C. – Me., Subcat. – Software and database support”. They branched out of the “C. – Methods able to increase accuracy of estimates” category. This decision was also supported by the observed compatibility with the feedback provided by expert P1.

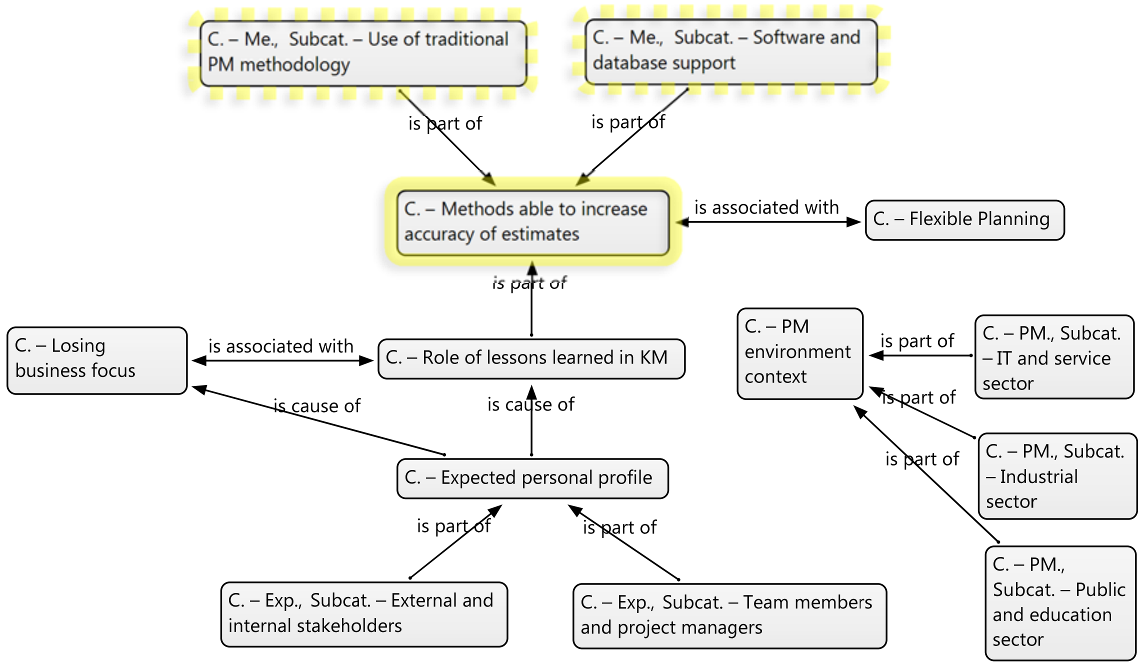

Figure 22 Axial dependencies between categories and subcategories updated after interview with S3

It is hard to predict if such a decomposing process of categories will continue. Nevertheless, the researcher rather applies here a careful policy so as not to unnecessarily complicate things. Further subcategorizing is conditioned by a potential increase in the saturation of concepts.

5.4.5 Conclusion

Reflection on findings

The S3 interview revealed some deep insights into the influence of contextual aspects within the public sector, increasing the significance level of many concepts in the network. Unfortunately, S3 concentrated mainly on identifying factors that could decrease the accuracy of estimates and did not contribute significantly to the development of new ideas and solutions. Nonetheless, two new subcategories emerged and the reflections provided are captured in the following list:

1. The political situation and elections may increase estimation bias between a project as planned and as executed.
2. Legislation can influence estimation since it imposes absolute deadlines.
3. The public sector is not well supported with methodological or technical tools.
4. Knowledge-sharing is not common practice in the public sector.
5. The role of external stakeholders is often significant in publicly financed projects.
6. The abandoning of the estimation process in the public sector may give rise not only to underestimation but also to overestimation: the result is subject to "roulette".
7. Priorities may not be stable in the public sector.

Interview/case categories covered and further actions

The interview with S3 covered more than one interview/case category. The public sector, international and external projects, and the traditional PM approach all remained in focus, but the respondent also indirectly addressed an industrial sector, primarily identified through analysis of the stakeholders/customers of the projects discussed.

In order to increase the trustworthiness of the findings, as already discussed, in the next step another practitioner working in the public sector should be interviewed. Such a strategy may help to identify more ideas of successful know-how – and not just "what fails" – in the public sector. During the subsequent data collection session, initial questions were moderated in order to verify the views provided by S3. The researcher was also of the impression that S3 addressed some of the problems associated with priorities in the public sector. Although this was not formally coded, the intention was to analyse this topic from the outset when it was possible to collect corresponding data.

With regards to the present coverage of contextual dimensions, there were still at least three additional inductive reasoning loops to be conducted, two of these corresponding to the public and industrial sectors respectively. In addition, a third expert could be consulted to verify the findings. This policy of consulting an expert proved its value by bringing together, in one single “move”, a number of cases and examples.

5.5 Public and education sector practitioner R1

5.5.1 Choice of the next respondent

Limitations of S3 insight revisited

S3 worked in the public sector but, in most instances, on projects being delivered to the commercial market. He described malfunctions within PM and estimation practices very well but – at the same time – he was not able to pin down the best tools to decrease the volatility of estimates: the interview was detailed but not creative.

Professional profile

R1 is active in the public and education sector where he acts as a project leader and sometimes as a team member. In contrast to S3, he delivers projects solely internally, to a group of campuses. These projects are large-scale endeavours, long-lasting and involving large teams. They aim mainly at the improvement of processes and the promotion of best practice. R1 has a clearly defined supervisor to whom he reports directly, describing him as "the boss". Although his projects are internal, they also involve external resources – that is, experts. Thus the estimation process, including budgeting, is vital.

5.5.2 Data collection

Place, time and tools

Due to interviewee constrained availability, discussion was split into two sessions. Each one was around thirty minutes long. They were independently recorded both on audio-video and audio recorder. The meeting took place during a peer review workshop. Confidentiality was assured.

Process of interviewing

R1 was precise but was not always able to correctly name tools or methods applied. He referred to many cases which increased the trustworthiness of findings. The initial questions allowed R1 to follow his own presentation of public and education sector related projects. However, discussion was divided into three stages, starting with question numbers one, two and three. The interview was conducted in the English language.

5.5.3 Data analysis

Transcription

Transcription was done in the language of interview. Body language was limited. The interviewee could be characterized as a person in control of his body language and verbal communication. Again Atlas.ti proved itself very useful in conducting a synchronized transcription.

Identified codes

The first iteration of coding was done simultaneously to transcription process. After this step, the process of coding was repeated in conjunction with analysis of the S3 transcript. This step was undertaken to verify understanding of public sector contextual characteristics. The interview with R1 increased the significance of many already identified concepts. Especially ones which refer to the public and education sector. The meeting introduced some insight into the role of deadlines. Thus, in the next step, the search for an opportunity to better understand this issue continues. That is to say, the dependency between the accuracy of estimates and practices behind the setting of deadlines/milestones. Similarly to S3, respondent considered public and education sector to be a specific one. Table 12 collects new codes and concepts as well as receiving the highest significance level increase.

Codes and concepts	**Sig**	**Den**
Access to information and history	9	1
Imposed and unverified deadlines	2	1
Internal stakeholder	5	2
Knowledge is hidden in lessons learned	6	8
Methodologies are used to support immature organizations	10	3
Milestones and deadline oriented schedule	4	2
Insufficient knowledge of scope of activity	4	2
Overly pessimistic	6	2
Public and education sector projects	12	6
Role of an expert	1	1
Simple IT tools and limited access to sophisticated ones	5	2

Table 12 New codes and concepts and major significance increase after interview with R1

Role of an expert code

This newly identified code even if with low at number one significance level seemed to be important to interviewee. R1 presented its influence on improvement of accuracy in the following way:

"We engage experts in the planning and execution phase. That is especially the case in relation to very complex projects."

Experts are perceived here as supporting the definition of the project scope and the resource requirements and therefore as indirectly supporting quantitative estimates. From the perspective of project deliverables it affects accuracy of estimates on the macro-scale level. R1 underlined the reason for an expert's support:

"Sometimes we engage experts – this happens because it needs to be clarified what needs to be done to get to a certain point and also what type of profiles we need."

Milestones and deadline oriented schedule code

R1 provided more insight on the role of deadline and supported with many examples, the view that his estimates were driven by deadlines corrected by his boss. Surprisingly it seemed that R1 was pleased with this situation:

"In general, my boss is the one that sets deadline." And continued …
"I tend to be driven by deadline, by specific deadlines. Instead of having multiple buffers, what tends to happen is that no matter what, I tend to produce the output. The difference is how deep the content of the output is."

It also seems that some flexibility in defining the project's scope may be an easier fit for the offered estimates. R1 followed:

"We were given eight months and finished in six months. That was because he said it should be done by this date."

It may also indicate that in some ways motivation can be driven by a proposed deadline. What if the personal profile of a supervisor and his or her expertise is related to estimating practices? R1 rather complemented his boss and seemed to be pleased with his cooperation on the planning process. He considered him to be major stakeholder:

"The main stakeholder is my boss, but also the members of the organization that participate in the project."

And further elaborating on his close cooperation with his boss:

"I think it is more the sense that this is our problem – we have to solve it. It is all about cooperation."

Simple IT tools and limited access to sophisticated ones concept

The name of "Simple IT tools used due to too expensive sophisticated ones" was shifted to the one provided in the title of this section. The new label broadens an understanding of the problem. Thus, it better supports the conceptualization process.

Overly experienced have tendency to overestimate concept

Codes "Too much experienced and managing mistakes" and "Experienced have tendency to overestimate" were reconceptualized and merged together into one new label. This decision was taken mainly on the basis of the earlier P1's and M1's input. The second code particularly remained unclear. It could, for example, indicate that experience is always related to the possibility of overestimation. The new label improved significance and clarified density/relationships within a conceptual network. The significance level increased to number four.

Categorization of concepts

One code was added. Additionally one code was renamed. Two other codes were reconceptualized into a new concept. Table 13 updates current view of these concepts in relationship to the categories.

Codes and concepts	**Categories**
Milestones and deadline oriented schedule	C. – Methods able to increase accuracy of estimates
Role of an expert	C. – Expected personal profile, C. – Methods able to increase accuracy of estimates
Simple IT tools and limited access to sophisticated ones	C. – Methods able to increase accuracy of estimates
Overly experienced have tendency to overestimate	C. – Role of lessons learned in KM

Table 13 Codes and concepts subordinated to categories

5.5.4 Axial coding, new relationships and shift in dependencies

Changes within the conceptual network

There were no major updates in the whole network of dependencies between concepts. Only "Role of an expert" was linked to the "Methods able to increase accuracy of estimates" concept. Other changes were technical and followed consequently the outputs of the coding process. For example, it covered changes to the codes' names or reconceptualization of concepts.

Changes within the axial network

R1 allowed a better understanding of the context of public and education sector projects with a focus placed on the education sector. Thus "PM., Subcat. – Public and education sector" became better conceptualised at the level of codes and concepts. Moreover, the new subcategory was added to "C. – Methods able to increase accuracy of estimates" and named "Me., Subcat. – Scheduling method". The motivation for its creation and definition for this subcategory was mainly driven by the interview with R1. He concentrated on the relationship between accuracy of estimates and more or less detailed planning; on the influence of the deadlines and indirectly stakeholders who impose them. It does not consider agile methods which are still subordinated under the "C. – Flexible planning" category which was originally introduced after P1. Agile techniques focus on rolling-wave planning, not on various scheduling techniques or the whole schedules. The above discussed changes are depicted in Figure 23.

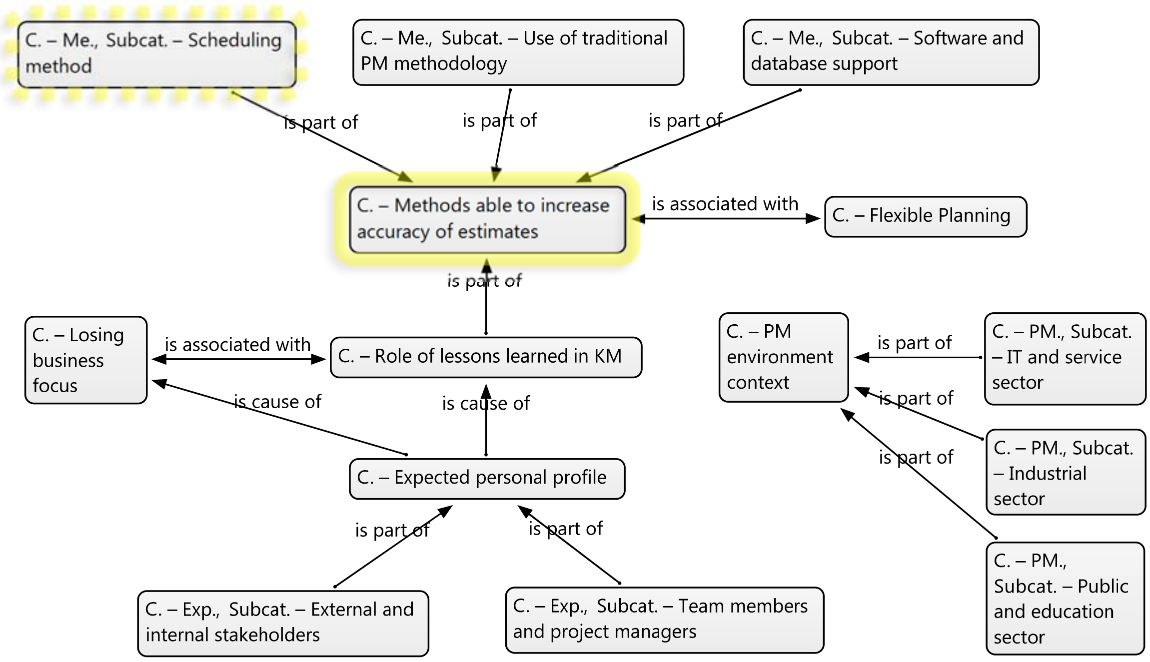

Figure 23 Axial dependencies between categories and subcategories updated after interview with R1

5.5.5 Conclusion

Reflection on findings

The following points do not represent any formal classification but rather are a collection of impressions provided by R1. They help to keep track of findings and to determine the research project's directions.

1. Experts external to the project help to develop a definition of the project's scope and the resources required.
2. The relationship between the project manager and his or her boss may help to decrease the inflation/overestimation problem.
3. The boss, as stakeholder, should represent relevant expertise which should allow him or her to engage in the planning process.
4. Correctly set and supported by stakeholders, a deadline helps in delivering on time or even earlier.
5. The public and education sector is very "specific" in nature.
6. The public and education sector is characterized by immature use of methodological and technical tools.
7. The public and education sector is not very efficient in sharing knowledge internally around good PM practices.

Interview/case categories covered and further actions

R1 offered the potential to cover more than one interview/case category. He was not designated as an expert but his interview strengthened understanding of public and education sector and, in addition, enabled a focus on internal projects and traditional PM approaches as well. For many aspects, R1 confirmed the views of S3 and allowed the further widening of the contextual dimension with regards to the education sector, mainly due to the deliverables associated with his projects. R1 provided a new view on the role of milestones and the impact of stakeholders and so, in the next step and before the planned expert interview, the search for an opportunity to more fully investigate these issues continued.

5.6 Observation OB1 and the influence of deadlines

5.6.1 Description of the situation

Place and time, PM environment context

The researcher conducted a three-day mentoring session in Warsaw, in which fifteen attendees from different industrial sectors participated. Observation OB1 and the resultant group interview was not pre-planned but arose more or less spontaneously and provided more insight into the impact of milestones/deadline in conjunction with the role played by major stakeholders. In this way it added to the conclusions derived from interviewing R1 and, in addition, provided coverage of an industrial sector context.

Data collection

According to the agenda, the mentoring session was not originally intended to focus on PM. However, the group started to discuss cases related to internal and external investment projects, introducing many examples and debating the link between estimation accuracy and milestones/deadline. At this point the focus switched to moderating the discussion in order to decrease the risk of having a homogeneously dominated group. Data was collected in the form of hand-written notes in English. Attendees were informed of the research project and gave their agreement to use of the data gathered.

5.6.2 Data analysis

Transcription and identified codes

Atlas.ti allows work on various source materials. Therefore, in consequence, collected data was transcribed and linked to already defined codes. Statements agreed by attendees were formulated in the form of quotations. In fact, mainly and repetitively the two codes listed below were under conceptualization process. It should be noted that “Internal stakeholder” represents solely the direct principal of a project manager. This was understood in the same way as during the interview with R1.

Codes and concepts	Sig	Den
Internal stakeholder	6	2
Milestones and deadline oriented schedule	6	2

Table 14 Codes addressed during group interview

Internal stakeholder concept

Fifteen people agreed that the principal of project manager may influence the accuracy of estimates. When thinking of estimates they said:

"… trustworthiness relates to the manager who sets deadline."

They have described this role as being characterized by knowledge, experience and an awareness of a project's scope. In their view project's scope was responsible for triggering potential overestimation. However, having the principal as a cooperating partner decreases volatility of the estimation process outputs.

Milestones and deadline oriented schedule concept

In another supporting conceptualization process observation related to the perception of an influence of a deadline strength, attendees stated that:

"Perception or the power of the deadline may fluctuate. Therefore, if the power of the deadline decreases, then priorities of the responsible person will start to fluctuate."

The respondents represented the industrial sector where typically, projects develop along the lines of other more repetitive daily responsibilities – for example, along with production or purchase schedule related duties. Under such circumstances, the "fluctuation" mentioned defines the competition for available resources. They said that these unstable priorities:

"… will imply necessity to re-estimate or re-schedule. Estimates may become updated."

5.6.3 Conclusion

Reflection on findings

This observation helped in the understanding of the relationship between R1 and his boss (principal) in terms of the estimating/planning process and the setting of priorities. Although the OB1 group did not represent the public sector, this should not be considered as a weakness. The project context discussed helped to better expose the problems of unstable priorities in PM, and the following reflections helped to manage the ongoing research pattern:

1. Unstable priorities affect the accuracy of estimates; milestones or deadline cannot be trusted and project starts to conflict with other responsibilities.
2. Being aware of the project's scope, the principal may develop the cooperation with project manager and through this reduce the chance of overestimation. Under these conditions, the project manager is less prone to unstable planning.

Interview/case categories covered and further actions

Furthermore, the observation improved the understanding of internal and external projects in the industrial sector, i.e. it widened the contextual aspects, and also helped to explain the stakeholders and deadlines phenomena identified during the interview with R1. The main strength of this observation was that the participants built their entire discussion on examples and case studies. Following this step, the previously defined research path involving an interview with a third expert was pursued. The researcher also planned to investigate the more positive effects of proper priorities management, as initiated by the interview with S3 and reinforced by R1 and OB1.

5.7 Expert K1's experience

5.7.1 Choice of the next respondent

Limitations of earlier research process revisited

The first two experts interviewed assured positive influence on levels of saturation. At this stage of the research, the third expert was involved in order to verify the conceptual network and improve significance levels. Contextual updates to the "C. – PM environment context" category might also be feasible as it only featured three dimensions at this stage. In addition, other contextual factors had been raised which could now be finally verified and subcategorized.

Professional profile

K1 is a consultant working in the field of PM. He has around ten years of experience, actively working in various industrial and service sectors, although his background does not cover the public sector. Nevertheless, for the majority of PM situations he is considered to be an expert. K1 also promotes his views on PM through relatively frequent conference presentations. He generally practises as a project manager, though sometimes works as a regular team member, and is also an entrepreneur.

5.7.2 Data collection

Place, time and tools

The interview was organized in a conference room. Confidentiality was assured. The whole process was around fifty minutes long. The interview was audio-video recorded. During this process the researcher documented responses and observations.

Process of interviewing

The language of conversation was Polish – the mother tongue of the interviewee. K1 took his time before answering questions. It was noticeable that he values his statements. Initial questions (numbers one, two, three, four and ten) from Table 4 were asked. Nevertheless, K1 independently opened new threads. He was precise in his language, named tools and techniques and his critical view was supported with examples.

5.7.3 Data analysis

Transcription

Transcription was done in Polish. Used citations were translated into English. Consequently, it was done with the use of Atlas.ti. Observations were also imported into this software.

Identified codes

K1 introduced many new codes. The interview with him became a trigger for a major update to the conceptual network. New codes were required to reanalyse already coded interviews. This, for example, became crucial in the case of the earlier R1 and, to some extent, S3 interviews. Table 15 represents the new codes and concepts. Some of them immediately became highly significant due to recoding of the earlier interviews.

Codes and concepts	**Sig**	**Den**
External stakeholder in over-formalized work environment	7	3
Intensity of change	1	3
Intellectual setup – multitasking	5	2
Knowledge hub	3	1
Multi-project-assignments work environment	1	2
Quiet hours	1	2
Stability of priorities	4	8

Table 15 Codes and concepts identified during interview with K1

External stakeholder in over-formalized work environment concept

“External stakeholder – within formalized work environment” was reconceptualized due to the number of cases indicating the problem of over-formalization. Over-formalizing somehow excludes external stakeholder from the estimation process. It disintegrates communication channels with the project team. Due to withholding or delaying part of the information, it results in a reduced accuracy of estimates. It becomes another argument for the development of work conditions that allow stakeholders to be an essential part of an estimation process – even if on macro-scale level.

Intensity of change code

The interviewee assumed that, regardless of source, there is some maximum level of intensity of change that a "project" can withstand. Above this level, priorities start to fluctuate in an uncontrolled way. While crossing this imaginable "border", estimates start to be recognized as not correct and uncontrollable. Stakeholders start to assume that some buffers were omitted and risks unidentified. All this happens because changes are too frequent and too intense. It could be compared to a machine which starts to malfunction when environmental conditions are too harsh.

Intellectual setup – multitasking concept

According to K1, sometimes, accurate estimates become inaccurate because they remain unprotected. This way of thinking characterized the whole discussion with the interviewee. This view was also raised earlier by S3 and in OB1. Lack of protection implies an increase in an earlier provided "Intensity of change". The label of the discussed concept contains the word – setup. The intention here was to indicate a similarity to the technological setup time which is measured in the repetitive/manufacturing sector. In PM, according to K1, this practice seems not to be the case. Thus, control over efficiency sometimes does not exist. K1 explained the decrease in efficiency in the following way:

> *"Multitasking: it means that you could accomplish a task in three days. Although if you have to change the task every thirty minutes then this estimated three days may double or even triple,"* and followed with … *"Yes, yes, even a short break results in having to re-focus."*

This all implies setup time. It could also be said that multitasking has two different "faces". On the one hand, this is an unwelcome situation since the decrease in efficiency results in being unable to meet an estimated deadline. On the other hand, having multiple skills allows team members to better react to frequent change. For example, one resulting from parameters being out of control. However, according to K1 this effect of promoting flexibility and efficiency is rather typical to the large organizations:

"Within an organization of a specific size statistics start to work. And if it's a larger organization, then that is certainly the case."

Knowledge hub concept

This code started to appear during the R1 interview. After K1 it become a visibly significant concept. The interviewee underlined that equally important to having knowledge is to know where and from whom get this knowledge. He simply said:

"A person has to know where to go to get knowledge."

Subsequently in one of the cases he praised related to the problem solution:

"Such people are in the department. They have their known places."

Again, K1 emphasized not only on knowledge but mainly on a functioning access to it at the time it was required.

Multi-project-assignments work environment concept

This concept was introduced as one of the elements influencing "Stability of priorities" in conceptual network. It remains related to another, also newly introduced code, "Intensity of change". K1 shared his experience of the multi-project oriented work environment. He considered this factor as one that amplifies the problem of inaccurate estimates – a sort of trigger waiting to expose the weaknesses of estimating. Due to the implied potential scarcity of available resources, he associated this phenomenon with underestimation. When asked specifically about underestimation he pointed to causes in the following way:

"Issues related to a multi-project, multitasking work environment."

Quiet hours code

Quiet hours require to silence unplanned communication in chosen periods of time during a workday. The defined code may be surprising but K1 considered "Quiet hours" to be an example of a simple, efficient technique and part of the observed good practices. Yet, the accuracy of estimates must be assured by decreasing uncontrolled multitasking. This code became a part of the "C. – Methods able to increase accuracy of estimates" category. At the same time it contradicts or opposes the "Intensity of change" concept. K1 promoted this idea quite directly:

> *"In one company where I worked – we had quiet hours."*

K1 seemed to focus on processes used by potential projects and the idea of increasing their stability. After all, processes serve the activities within project schedules. Project context may define situations where it is more or less probable to successfully implement this technique.

Stability of priorities concept

Due to its density within the conceptual network, this new code immediately became a concept. The researcher again reanalysed R1, S3 and OB1 transcripts. It was one of these moments within the research project when suddenly more ideas interlinked under a well-defined concept label. The conceptual network became clearer. Generally speaking, and as indicated in Figure 24, the network was rebuilt around the "Stability of priorities" concept – as it was similarly rebuilt around "Knowledge is hidden in lessons learned", as already seen. It is expected that this sub-network will continue to develop.

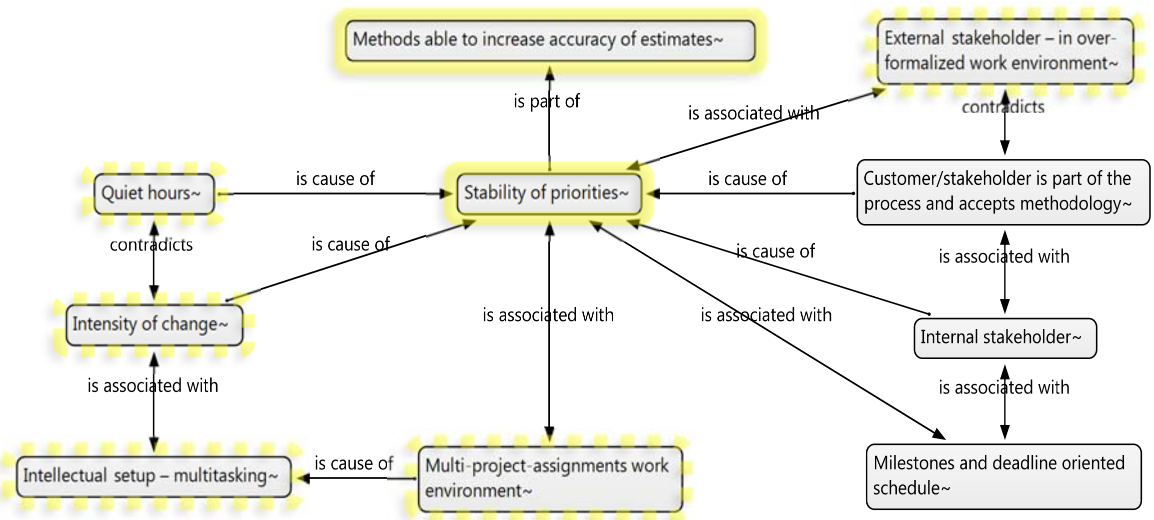

Figure 24 Density of "Stability of priorities" concept

K1 addressed the topic of "Stability of priorities" for most of the interview – not always directly but he gave the impression that a project manager might lose accuracy of estimates as a result of own behaviour. He or she should protect priorities related to his or her own team. The question arises as to whether a project manager has a full set of powers? K1 was in no doubt when it comes to the priorities management:

"Another problem is related to the protection of your own project team from other activities. To allow them to stay focussed."

Categorization of concepts

As presented in Table 16, the newly introduced codes and concepts were assigned to corresponding categories. "C. – Priorities management" was frequently used and it is discussed in more detail in the axial coding dedicated section.

Codes and concepts	Categories
Intensity of change	C. – Priorities management
Intellectual setup – multitasking	C. – Priorities management
Knowledge hub	C. – Role of lessons learned in KM
Multi-project-assignments work environment	C. – Priorities management
Quiet hours	C. – Methods able to increase accuracy of estimates
Stability of priorities	C. – Priorities management

Table 16 Codes and concepts subordinated to categories

5.3.4 Axial coding, new relationships and shift in dependencies

Minor changes

Minor corrections could be addressed to the types of dependencies. It was mainly as a result of the changes in the names of codes and concepts. To facilitate this problem, a repeated analysis of data that had been transcribed previously was needed.

Major update

At this level of complexity it is sometimes difficult to efficiently work with a conceptual network. Categories are more convenient to support a general perception of relationships. Nevertheless, this is a conceptual level which helps to verify dependencies between categories and subcategories. In the conceptual network the major change was to group concepts around the "Stability of priorities". It found its reflection in Figures 24, 25 and 26 which show dependencies between categories. It should be also mentioned that a new concept – "Knowledge hub" – was linked to "Knowledge is hidden in lessons learned".

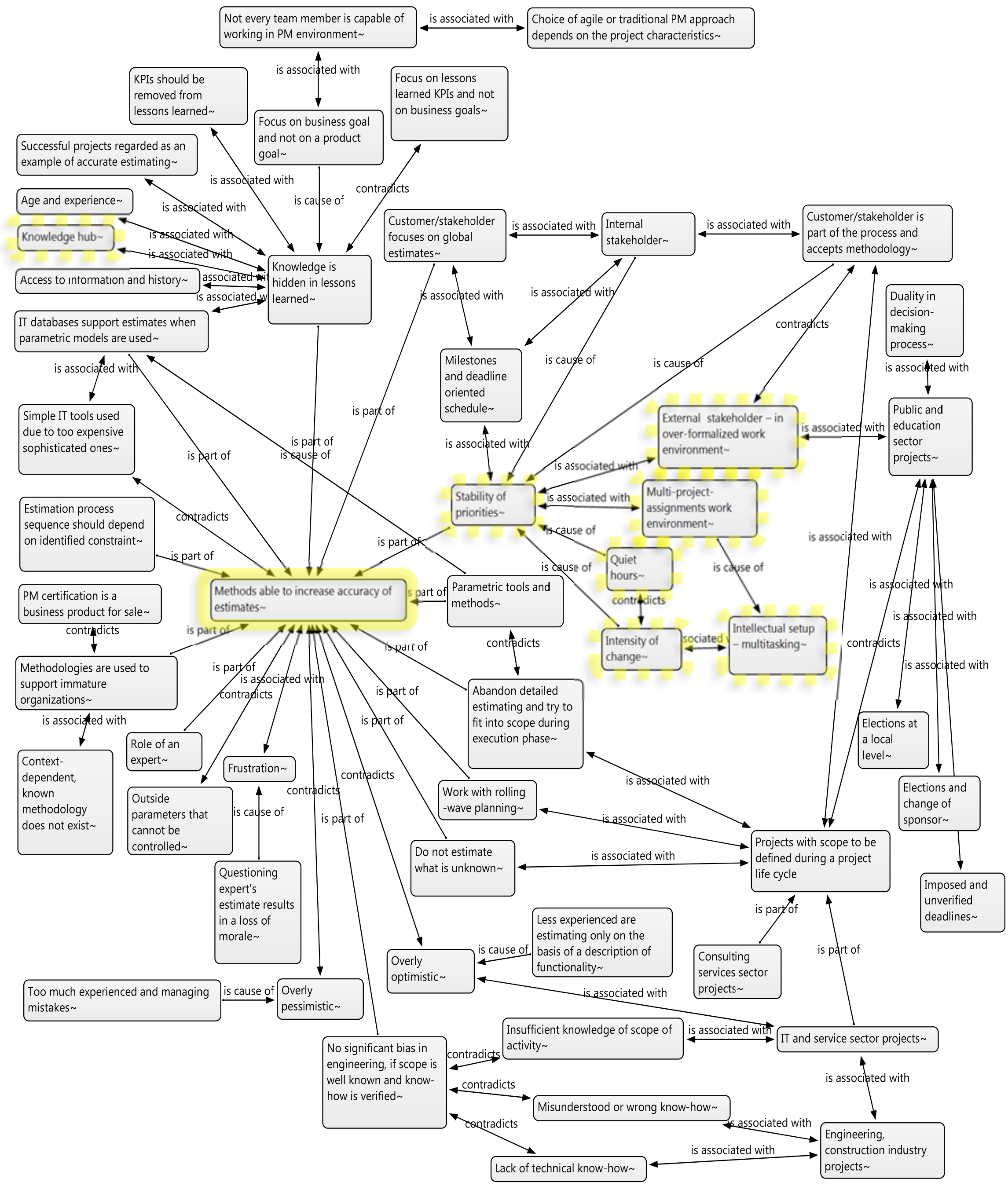

Figure 25 Conceptual network updated after interview with K1

Enlargement of "C. – PM environment context" dimensioning category

K1 referred to the size of the organization. He considered this as an element that influences accuracy of estimates. That is why the contextual subcategory "C. – PM., Subcat. – Large and small organizations/projects" was added. He also sustained, as observed in earlier interviews, references to internal and external projects. Logically, the corresponding subcategory was introduced as well. Finally, the issue of single or multi-project-assignments work environment was discussed. K1 presented this as a component being influential to the frequency of estimates updates. This subcategory was named "C. – PM., Subcat. – Single or multi-project-assignments work environment". The discussed changes to axial coding are depicted in Figure 26.

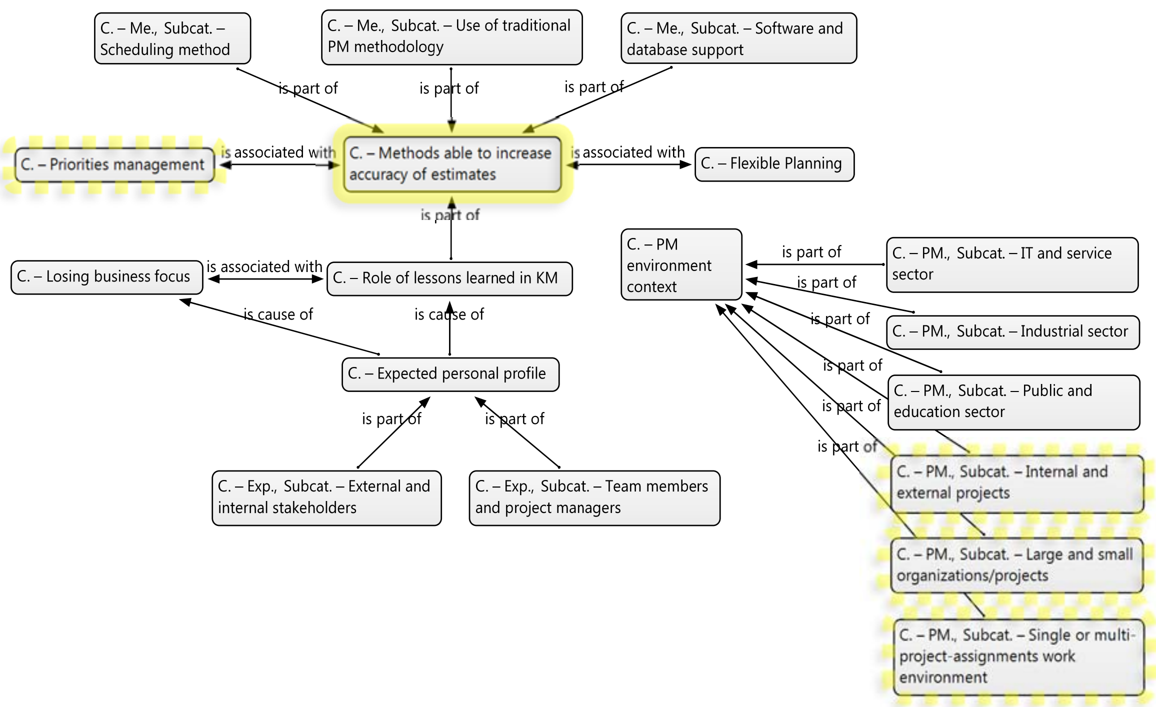

Figure 26 Axial network updated after interview with K1

"C. – Priorities management" category

"Stability of priorities" became a new major element within a network of concepts. The one having relatively high density. It pulled a number of codes to itself and thus achieved a level of importance that allowed it to be categorized – as depicted in Figure 26. This new category is a result of inputs provided by R1, S3, OB1 and expert K1. Axially, "C. – Priorities management" remains associated with the "C. – Methods able to increase accuracy of estimates" category.

Update to interview/case categories list

The practice of interviewing followed initial questions from Table 4. They have proven their usefulness as triggers for discussions. Similarly, at the beginning of the inductive reasoning process, context was dimensioned along interview/case categories defined in Table 3. It supported the contextual placement of respondents and a better control of search directions. A recent update made to the

"C. – PM environment context" category required the implementation of a corresponding change in the interview/case categories classification list. Initially used in Table 3, the proposed dimensioning list was extended and is provided in Table 17.

ID	Interview/case categories
1	Expert interview
2	Industrial sector
3	Service sector
4	Public sector
5	Internal projects (internal project sponsor)
6	External projects (external project sponsor)
7	Traditional PM approach
8	Dynamic/agile PM approach
9	International projects
10	Small projects
11	Large projects
12	Single-project work environment
13	Multi-project-assignments work environment

Table 17 Interview/case categories updated after interview with K1

Reflections and critical view

K1 helped to define and increase the understanding of many of the already defined codes. This became a milestone toward the formulation of the framework and is visible in formulating answers to research objectives. The collected impression persuades the researcher that K1's expertise and the examples he introduced, also support the understanding of the "Overly optimistic" and "Overly pessimistic" concepts.

Another reflection is that the category "C. – Methods able to increase accuracy of estimates" produced new categories and subcategories. When category is "dense enough" it acts as a hub setting up new nodes (subcategories). This, for example, transpired in the case of the "C. – Priorities management" category. This situation supports the conceptualization and saturation process.

5.7.4 Conclusion

Reflection on findings

The list below shows the ideas and main thoughts offered by K1 and these helped to determine the next steps in the research:

1. Intensity of change above a certain level makes the estimation process uncontrollable and unmanageable.
2. Intellectual setup, especially in the multi-project-assignments work environment, decreases efficiency and results in underestimation being observed. Nonetheless, in large organizations "statistics start to work". This refers to the idea that having multi-skilled team members may be helpful in dynamically reassigning resources to other activities.
3. The "Knowledge hub" concept indicates that knowledge sources should be clearly defined in order to support the estimation process.
4. The "Quiet hours" technique protects estimates by introducing periods where team members are left to their work and disturbance is prohibited.
5. Stability of priorities is dependent on a project manager being able to protect his or her own team from unplanned activities.

Interview/case categories covered and further actions

K1 covered a wide range of the contextual interview/case categories from Table 17: expert interview, service sector, internal and external projects, traditional PM approach, small and large projects, and single-project and multi-project-assignments work environments. From this perspective, expectations were met and even exceeded. In the next step, an observation which addressed the underestimation problem is presented. Two other interviews – one with an expert from the industrial sector and one with a practitioner from IT – are also planned for incorporation into the inductive reasoning process.

5.8 Observation OB2 addressing the underestimation problem

5.8.1 Description of the situation

Place and time

Two separate meetings were held in a company operating in the IT sector and were dedicated solely to estimation process. Each of the two involved independent meetings over a two-day period and, together, they contributed thirty-two hours of discussion of the problem of inaccurate estimates and general planning. Around ten people participated in each meeting.

Data collection

The interviewees were informed of the research project in order to obtain their consent to make use of the data collected. The only limitation was that in these group interviews recordings were not allowed – neither video nor audio. However, the use of quotations, photos, drawings, diagrams and hand-written notes was allowed, and data was collected in the Polish language.

Care was taken not to influence the data collected – this practice was self-assuring as the two meetings were positioned as an analysis of the current state and, therefore, it was not anticipated that the researcher would propose any solutions: all description of the current situation, best practices and ideas came from the customer's side.

5.8.2 Data analysis

Transcription and identified concepts

Transcription and coding was carried out directly on the basis of hand-written notes, quotations, graphs and diagrams. Atlas.ti was used to code directly on the diagrams and graphs. It was an efficient, visualized way to work that allowed an increase to the saturation levels of many already identified codes.

This quite long observation introduced only two new codes, which may indicate that the model and collected data had achieved a certain level of maturity. Discussion mainly confirmed the significance of many already known findings. As is typical of long-lasting business meetings, similar topics and arguments come back again and again. Newly introduced codes are provided in Table 18.

Concepts	Sig	Den
Competences should be transparent	1	1
Too stable schedule is not credible	1	1

Table 18 Concepts identified during two OB2 meetings

Competences should be transparent concept

This idea – that someone's competence should be transparent to other project stakeholders – should not really be new to the business world. However, within this research project it was by name indicated for the very first time. Both groups independently expected this requirement to be fulfilled, especially in the multi-project-assignments work environment. Attendees referred to both soft and hard competences with significant attention paid to the second ones. One of interviewees presented this view in the following way:

"Especially when it refers to hard ones – they should be transparent to other team members. Not only within one project team."

This calls for general transparency. Transparency independent to a particular project. This would be perceived as a general improvement to the processes supporting projects and other resource-requirement sources.

Too stable schedule is not credible

This concept indicates two aspects. First, suggests that total elimination of estimation process variability is not possible. Second, it shows that if a project seems to possess only accurate estimates, then the whole situation may be considered as an indicator of the wrong PM practices being applied. One of the attendees said:

"A super-stable schedule may indicate many things but it should not suggest an accurate estimation process."

Moreover, interviewees indicated the potential causes of this "lack of estimate bias" and "super-stable" schedules. They could be:

1. An example of an overestimated project.
2. Extensive use of resources. Here, even issues related to breach in labour law were raised.

3. An indicator that bias was “covered” by update to contractual agreement.

On the basis of their examples and cases, both interviewed groups agreed that regardless of the cause of lack of volatility, the whole situation becomes suspicious. This interesting observation introduces an indicator triggering careful analysis of applied PM practices.

Increase in significance of already defined codes and concepts

Both sessions increased understanding and significance of the twelve already defined codes and concepts. Table 19 depicts only those most increased in significance level.

Codes and concepts	**Significance level increased by number**
Knowledge is hidden in lessons learned	4
Methods able to increase accuracy of estimates	3
Insufficient knowledge of scope of activity	3
Overly pessimistic	2

Table 19 Increase in significance of codes and concepts after OB2

Categorization of concepts

The “Too stable schedule is not credible” concept was considered in the corresponding category as a warning sign. The “Competences should be transparent” concept helped to better understand the “C. – Expected personal profile” category.

Concepts	**Categories**
Competences should be transparent	C. – Expected personal profile
Too stable schedule is not credible	C. – Methods able to increase accuracy of estimates

Table 20 New concepts subordinated to categories

Conceptualization and axial coding process

New codes were put into a conceptual network. There was no major shift in the relationships observed. Similarly OB2 did not shift dependencies between categories and subcategories. Axial coding resulted mainly in the strengthened dependability of the network.

5.8.3 Conclusion

Reflection on findings and collected research experience

Observation OB2 helped to provide a new experience in relation to the research methods applied. Graphs, diagrams, hand-written notes and informal conversations appeared to be at least as valuable as a formal interviewing process. Group interviews introduced similarly interesting results. Attendees tried to solve the problems encountered through use of their knowledge and the cases they discussed. Nevertheless, the homogeneity of the group persisted as a risk. The principal reflections, which helped to maintain a grip on the inductive approach, are summarized below:

1. Competences, both soft and hard ones, should be made transparent. This does not refer only to PM.
2. "Super-stable" schedules could be considered as indicators of inefficient business practices, with an absence of bias seen as suspicious.
3. Being overly pessimistic or optimistic may be a function of people's age and experience.
4. Being overly pessimistic and overestimating can be a consequence of external personal factors, not directly related to the job of work.
5. A milestones-oriented schedule may improve the accuracy of estimates, at least in statistical terms.

Interview/case categories covered and further actions

Analysed contextually and in accordance with the classification of Table 17, the interviewees represented an IT sector that offered media intelligence services to monitor social media in both the private and public sectors. The majority of projects discussed were external but some internal ones were also delivered to improve the IT tools used. Use was made of both traditional and dynamic approaches, and services are offered to domestic and foreign customers. Their multi-project work environment contained a mix of small and large projects. In the next step of the research, it is planned to continue with this investigation into the IT sector.

5.9 IT sector practitioner S1

5.9.1 Choice of the next respondent

Choice of the next interviewee and his professional profile

S1 is a practitioner in the IT field and has more than ten years of experience. He works in an international environment as a project manager with responsibility for the delivery of ERP system implementations to both private and public sectors.

5.9.2 Data collection

Place, time and tools

The audio-video recorded discussion took place in a business lounge and was forty-five minutes long. Hand-written observations were collected as well. Additional methods, similar to these used during OB2 were not applied.

Process of interviewing

Discussion was more aimed at the verification of earlier collected reflections, analysis and observations. The interview was conducted in English. S1 was somewhat pessimistic. On the one hand he promoted a need to increase accuracy of estimates but he suddenly said:

"Honestly, Adam, I do not think that we can do a lot because it is, in the end, subjective and it depends on personality."

Although this statement was not very hopeful, fortunately from the perspective of the axial coding process it strengthened the "C. – Expected personal profile" category. Thinking of his pessimism, it is interesting to note that even though it was somehow expected that S1 would refer to the private sector, he preferred to discuss projects delivered also to the public sector. Is the public sector, as S3 preferred to indicate, "very specific"?

5.9.3 Data analysis

Transcription

Transcription was carried out in Atlas.ti in the language of the interview. No new techniques were applied. Video-recorded material was used to better collect and reanalyse observations.

Identified codes

The interview strengthened the understanding of the fifteen earlier identified concepts, especially those related to knowledge management, databases and being overly optimistic or pessimistic. In the area of tools supporting knowledge sharing and knowledge access management, S1 represented the highest standards, at least when compared to earlier collected data. A proactive approach to learn from mistakes and build from lessons learned was permanent. For that matter, he said:

“First, I do not blame anyone.”

When asked about sharing knowledge, he replied immediately and subsequently provided detailed examples. He valued the best KM practices:

“Of course we do that.”

The interview introduced two new codes which fit into already defined categories and the conceptual network. They are provided in Table 21.

Codes	**Sig**	**Den**
Introduction to a job position	1	1
Personal characteristics may not allow an increase in accuracy of estimates	1	1

Table 21 Codes identified during interview with S1

Introduction to a job position code

This method was described as one decreasing the negative effect of job rotation. S1 also recognized this element as one supporting a reduction of the problem related to initial lack of experience. He considered use of this method as not always necessary:

"Yes, we have an orientation programme. One or two days – it depends on how much each new employee needs that orientation programme."

Personal characteristics may not allow an increase in accuracy of estimates

S1 often referred to predictability which in his view is very low in the case of personal profile. S1 is an engineer not a psychologist. It could somehow affect his perception of the problem. He considered a personal profile as being unpredictable:

"What you are is different from individual to individual."

Categorization of codes

As presented in Table 22, two new codes were subordinated to the "C. – Expected personal profile" category. S1 discussed widely many different, already existing concepts. Here, his view did not change relationships to already defined categories.

Codes	**Category**
Introduction to a job position	C. – Expected personal profile
Personal characteristics may not allow an increase in accuracy of estimates	C. – Expected personal profile

Table 22 New codes subordinated to categories

5.9.4 Axial coding, new relationships and shift in dependencies

Conceptual network

Two new codes were incorporated into conceptual network. “Personal characteristics may not allow an increase in accuracy of estimates” was considered as a new code associated with KM. As depicted in Figure 27 all concepts from “C. – Expected personal profile” category were grouped around the above mentioned code.

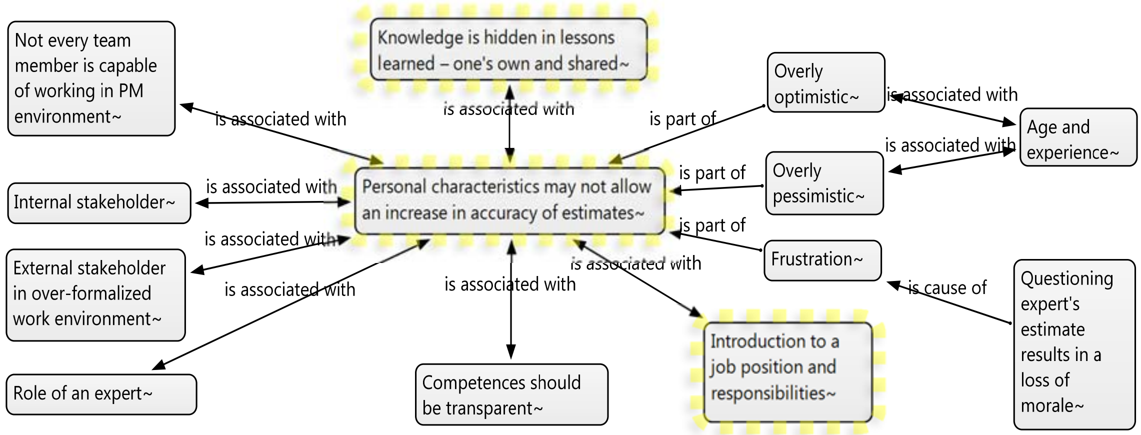

Figure 27 Conceptual network around “Personal characteristics may not allow an increase in accuracy of estimates”

At the same time, “Knowledge is hidden in lessons learned” was reconceptualized to “Knowledge is hidden in lessons learned – one’s own and shared” to better reflect the view on the problem presented by S1. He considered lessons learned as those being in a person’s mind and as those contained in the database or shared through formal improvement of the PM processes.

Relationships between categories

After having implemented updates to the conceptual network, understanding of axial coding process became more transparent. The process of managing lessons learned is related to personal profile. This is visible both at the conceptual network level and at the axial coding level in terms of dependencies between categories.

One dependency has changed their type when compared to the previous depiction of the axial coding graph. Moreover, S1 allowed to verify a few labels of project context dimensioning subcategories. "C. – PM., Subcat. – IT and service sector" depicted in Figure 28 was justified by S1 and his general promotion of the view that in today's business, these sectors often blend together. Another verification was related to "C. – PM., Subcat. – Large and small organizations/projects". Yet, in the majority of analysed cases, large organizations were mainly occupied with large projects. Similarly, small organizations gravitated more toward small projects. It cannot be considered as a permanent dependency but on the basis of gathered and analysed data it can be assumed that to some extent such a relationship exists.

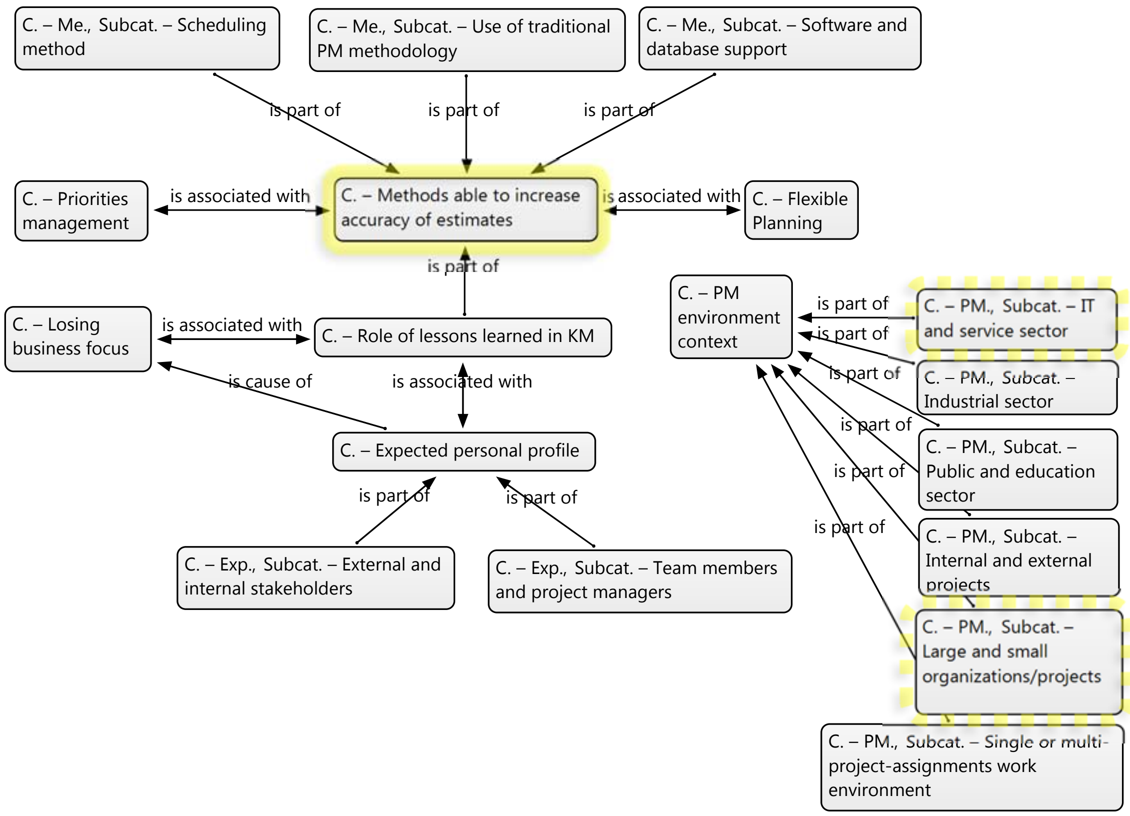

Figure 28 Axial dependencies updated after interview with S1

Corresponding changes were also applied to interview/case categories – those used to keep control of the interviewing process and managing a set of applied questions.

5.9.5 Conclusion

Reflection on findings

S1 certainly strengthened many of the codes that had already been defined and also enriched understanding of the public sector dimension where he primarily complained about poor communication. He had a technical background and placed a lot of trust in IT tools, considering personality to be generally unpredictable in its effects. The primary reflections derived from S1 are, briefly, as follows:

1. Lessons learned are dependent on personal characteristics. They are also influenced by systems of knowledge sharing, individual attitudes and technical solutions.
2. Sometimes it may be difficult to improve the accuracy of estimates, mainly due to the unpredictability of personal characteristics.
3. Orientation programmes may help to overcome problems related to the unpredictable effect of individual personal characteristics.

Interview/case categories covered and further actions

The project manager, S1, represented the IT and service sector, with experience mainly gained from delivering to the public sector. He focused on external projects, mostly supported by a traditional PM approach.
The interviewee discussed the perspective of large organizations and projects undertaken in an international and multi-project work environment.

S1 pointed to the automotive industry as one providing an example of a more favourable context in support of the estimation process, and of delivering more accurate estimates. For this reason, attempts to find an expert in the industrial sector continued, with the focus placed ideally on the automotive industry.

5.10 Practitioner A4's experience

5.10.1 Motivation to adopt this specific approach

This research project was itself considered as a case study that could be associated with the discussion of the accuracy of estimation. An advance in the timeline of the scientific investigation allowed an analysis of the researcher's own reflections in relation to addressing underestimations or overestimations and the general stability of estimates.

5.10.2 Data collection

Place, time and tools

The interview was audio recorded and took around forty-five minutes. Discussion was conducted in a conference room and was organized as a Skype teleconference.

Process of interviewing

The researcher could not reflect on this scientific project alone. Such an approach could be biased by other experiences, subconscious choice of questions and other projects related to professional responsibilities. Therefore, the researcher asked another person to interview him. It was a requirement that the interviewer was a PM practitioner. He was instructed to investigate whether estimates were accurate or not, what causes were observed and what improvements could be applied. Nevertheless, no specific list of questions were used. Due to the character of the meeting it was not possible to apply intensive interview principles. For example, there were no discussions and comparisons of multiple cases, or cross questioning.

5.10.3 Data analysis

Transcription

The process of transcription was merged with a process of coding in Atlas.ti. During transcription it was frequently necessary to analyse previous texts to assure correct interpretation of used codes and concepts.

Identified codes

A4 improved the significance of sixteen codes in which three were newly proposed. Table 23 lists only those newly identified.

Codes	Sig	Den
Effect of best and wrong practices	1	1
Dedicated IT tools (functionalities are consistent with deliverables and project context)	1	1
Methodology should correspond to a project and its context	3	1

Table 23 Codes identified during analysis of A4 transcript

Effect of best and wrong practices

A4 provided a view to some extent related to that coined by Merton's (1948) expression of the "self-fulfilling prophecy". If the process of estimating is biased it may drive the project the same way in the future. Similarly, the best practices tend to support themselves as well. It could be recognized as a rolling circle where the question is only – in which direction? He said:

"This effect can be demoralizing. If you have inaccurate estimates you may produce even more inaccurate estimates."

Dedicated IT tools

In earlier interviews IT was mainly considered from the perspective of databases. A4 referred here more to the functionalities related directly to the deliverables of a project. He simply expressed the positive aspects of using Atlas.ti. In his view it indirectly helped to stabilize the accuracy of estimates. The level of predictability of "how much time it will take" increases if tools correspond to project deliverables and project context through offered functionalities. A4 summarized:

"I think that they increased stability of the estimation process."

Methodology should correspond to a project and its context

The applicability of PMMs was usually discussed from the perspective of the maturity level of a PM oriented organization. A4 in reference to the research project, promoted the view that a methodology should be customized – not necessarily to each project but certainly to a particular type of contextual environment. He expressed this in quite an emotional way:

"It should be, it should be. I have learned a lot of things that I would apply if I could start this project again."

Categorization of codes

Before categorizing, the descriptions and labels of categories were checked to support formulation of the framework. Subordination of concepts between categories and subcategories was checked again. Even though in the Table 24 only new codes are visible, improvements were applied to the complete list.

Codes	**Category and subcategories**
Effect of best and wrong practices	C. – Methods able to increase accuracy of estimates
Dedicated IT tools	C. – Me., Subcat. – Software and database support
Methodology should correspond to a project and its context	C. – Me., Subcat. – Use of traditional PM methodology

Table 24 Codes subordinated to category and subcategories

Minor changes

The label name of "Relationships between team members and time on projects" code was changed to "Relationships between team members". It was done mainly to avoid unnecessary confusion. Changed code, partly covered meaning of "Age and experience". A4's input also helped to widen the meaning of "Introduction to a job position" to "Introduction to a job position and responsibilities".

5.10.4 Axial coding, new relationships and shift in dependencies

Three new codes were added to the present dependencies. No significant changes were made to the network.

5.10.5 Conclusion

Reflection on findings

The session, facilitated by an external interviewer, can be regarded as successful. As well as introducing a few new codes, it allowed time to focus and reflect on what had been learned to date in the course of this research project. The ideas that have emerged at this stage can be summarized as:

1. IT solutions should correspond through their functionalities to the context and deliverables of a specific project.
2. Methodologies should be formulated in response to particular types of contextual environment.
3. Potentially, the best and wrong practices in relation to accuracy to estimates tend to reinforce themselves, and skew future projects towards similar outcomes.

Interview/case categories covered and further actions

The interview considered the research as having the contextual characteristics of the education sector and providing an example of an international project. It employed the traditional PM approach within a single-project work environment and was considered as representing an external project. In the next step, an expert is engaged to verify the saturation levels of the findings identified to date.

5.11 Industrial and automotive sector expert K3

5.11.1 Choice of the next respondent

Justification of choice

The public, IT and service sectors have already been well covered. Practitioner S1 pointed to industry and the automotive sector as areas where problems related to inaccurate estimates are smaller, at least when compared to the IT and service sector projects.

Professional profile

Expert K3 has more than ten years' experience in the automotive sector. She manages and works on projects run for major players in the German automotive market, and presents a clear view of the problems and causes relating to the accuracy of estimates. She could be characterized as a very proactive person and one that is very knowledgeable about what method should be applied and when.

5.11.2 Data collection

Place, time and tools

Discussion took place in a conference room and was around one hour long. The whole interview was audio recorded and hand-written notes to support observations were taken.

Process of interviewing

K3 presented a clear view and introduced number of cases to justify her standpoint. Although she didn't go into many details, she used various examples to assure the interviewer of the correctness of her opinion. Her engagement in the discussion was at its highest at the end of interviewing process (other experts interacted more actively from the beginning of the conversations). The interview process covered all ten initial questions from Table 4. Additionally, she was asked her opinion of the codes with the least level of significance. This verification process was scheduled to the last part of the interviewing session in order not to bias earlier answers.

5.11.3 Data analysis

Transcription and identified codes

Transcription was carried out within Atlas.ti. The process of coding was run concurrently. It was also necessary to recode a few of earlier transcribed texts. K3 addressed twenty codes and within them added two new ones.

Codes	**Sig**	**Den**
Customer/stakeholder should see combined plan of all involved parties	3	1
Reduce complexity of communication channels	6	1

Table 25 Codes identified during interview with K3

Customer/stakeholder should see combined plan of all involved parties code

In complex industrial projects customer often does not recognize all of the involved schedules, which means that these schedules do not "see" each other. One subcontractor dependent to another may not be aware of the risks and constraints on resources affecting the schedules of a business partner. This was quite surprising although the revealed cases left no ambiguity. K3 described the potential result of such a situation:

"We have plenty of time but some subcontractors appear in the project too late."

Giving the reason that nobody had verified the related schedules to check when these subcontractors could start work.

Reduce complexity of communication channels code

K3 represented typically larger scale projects involving a number of different companies. A major list of problems affecting the accuracy of estimates resulted from communication channels being too complex. When asked if indeed complexity was to blame, she said:

"Yes, very much …" Followed by a very long pause.

Each time this topic was raised she immediately started to complain and raise a number of issues depicting the loss of accuracy.

Categorization of concepts

Table 26 depicts the categorization of a new codes. No changes in descriptions or meaning were applied.

Codes	Category and subcategory
Customer/stakeholder should see combined plan of all involved parties	C. – Exp., Subcat. – External and internal stakeholders
Reduce complexity of communication channels	C. – Methods able to increase accuracy of estimates

Table 26 Codes subordinated to category and subcategory

Minor changes

K3 referred to parameters that are out of her control or influence. She indicated here both internal and external parameters. Therefore, the meaning of "Outside parameters that cannot be controlled" concept was broadened and named "Parameters that cannot be controlled". K3 also addressed the stability of processes. Consequently, an extension of the description was made and "Parametric tools and methods" was renamed to "Parametric tools and standardized methods/processes". To better fit the presentation of the other dimensioning context subcategories, "Engineering, construction industry projects" concept was updated to the name "Industrial, engineering and construction sector projects".

5.11.4 Axial coding, new relationships and shift in dependencies

Two new codes were added to the conceptual network. No changes were introduced to dependencies between categories.

5.11.5 Conclusion

Reflection on findings

The views of K3 added two new codes and strengthened almost fifty percent of the concepts already defined. Dependencies within the axial coding process were not changed, even though K3 was an expert who could easily have undermined some of the thoughts already collected. There were still open issues around the types of dependencies used in Atlas.ti to manage the axial coding process, but these dependencies remained unaltered by K3's input.

Interview/case categories covered and further actions

K3 addressed the contexts of the industrial sector and external projects and their use of specifically designed methodologies. The PMM used could not be classified as an example of a traditional or dynamic/agile approach, as it had been locally developed. The projects discussed were of a large scale and international in character. The work environment was multi-project oriented.

The next steps in the research continue to collect findings and reflections, particularly through observation OB3, but due to space constraints they are employed in the next chapter as part of the discussion focused on determining answers to the research objectives.

6 Discussion of findings

6.1 Introduction

Chapter 5 provided a view of the conceptual evolution, supported by an inductive approach, in a fairly sequential way. On the basis of the cognitive and explorative journey undertaken in this research, the present chapter serves initially to deepen discussion and then to draw conclusions and form responses to the research objectives identified in Section 1.5.3. The research strategy, alongside other objectives, principally supports the formulation of a new framework for a more realistic estimation process in PM. In addition, further discussion of the findings in light of the literature brings the chapter to a conclusion along with reflections relating to the research strategy applied and the use of CAQDAS system.

6.2 PM environment revisited – contextual world

6.2.1 Contextual factors as a combined basis of any PMM

From the very beginning of this research process it was assumed that PMMs only reflect contextual situations. Improvement in accuracy of estimates could be achieved but always with attention paid to a project's individual contextual background. It was observed that in business practice, someone may through project context manage use of applicable tools.

There were no data collected that would favour any formal branded methodology or lead to one being considered as a universal solution to the problem of inaccurate estimates. If methodologies were addressed by the interviewees at all, then it was from the perspective of tools and techniques. PMMs were mainly invoked in the public sector or as support for organizations inexperienced in PM.

However, there were some traits displayed in approaches to the problems discussed that could be linked to the general perception of PMMs. For example, inaccurate estimates provoked two types of reaction: either avoidance of the problem by applying dynamic/agile approaches, or direct improvement of accuracy of estimates by more effective application of reasonably well-known tools and techniques. The latter approach was also the more creative one in sometimes proposing new – or at least more unusual – methods and ideas. Nevertheless, PMM brands were still avoided. These two types of reaction are consistent with the objectives of this research, particularly the fifth one.

6.2.2 Experts, practitioners and observations

Experts' perception of PM

Experts can be generally characterized in terms of already possessing contextual, often generalized thoughts and views that are well formulated. Even though they are well educated in PMMs, they seem to avoid following them. Experts tend to focus on best practice examples, business stories and comparisons. They bring to the agenda contextual factors related to one tool or technique or another. Some of their input supports familiar tools and addresses their level of importance, while some represents ideas which may be slightly more unusual. Their approach was more holistic, taking into account a greater number of cases. During the research process, and especially within the axial coding stage, the contextual factors raised started to be called dimensions as captured in Table 27. Dimensions determined the use of particular tools and techniques.

Experts appeared to be comparable to academics in terms of providing a wide coverage of topics. However, in the field of PM, academics "often lack the practice based knowledge of the discipline" (Morris 2013, p.16). It seems that experts are able to avoid this risk and their views are well supported by PM stories and case studies.

During the research project, it became apparent that the best solution is to collect ideas from experts, test those ideas and then confront the experts with the new data arising. In practice, such a neat approach would be difficult to achieve. It is sometimes difficult to persuade them to contribute free of charge for the purposes of a research project. Nevertheless, the ability to compare experts was a milestone responsible for significant increases in trustworthiness and quality. The idea of starting the whole process with two experts enabled early clarification of the contextual view of many associated problems.

Practitioners' insight

From the perspective of context, PM practitioners were consulted to complete the data reporting/story. They typically referred to their specific PM experiences and stories. Contrary to experts, their knowledge should be characterized as more limited but more focused on specific niches. Indeed, "Practitioners are at the sharp end of ‘a’ reality but generally lack the breadth of knowledge” (Morris 2013, p.16). They differed from experts in addressing project context in a narrower way. They usually discussed less diverse cases and addressed a more limited number of contextual aspects. Their self-criticism was often perceived as complaint.

Care had to be taken to ensure that practitioners’ contributions were not biased by PM paradigms. The researcher had the impression that practitioners sometimes lacked understanding of, or insight into, PM methods and simply followed them by rote. For example, practitioners could be influenced by a coaching session. They were primarily consulted in order to better understand differences between projects in industry, the public sector and those in the IT/service sector.

Observations and group meetings

Opportunities to observe arose due to constant work in the field of PM. For example, during OB2, attendees were observed in both discussion and argument. There, dispute around the concepts being advanced and criticism was almost constant. Observations also could last a long time. As depicted in Figure 12, OB3 defines forty-five days spent during two years in one international corporation. In such a situation the number of PM cases is sometimes overwhelming. OB3 became almost synonymous with a longitudinal approach but it was always considered as a set of observations used to verify findings. It did make it possible to observe repeatedly whether one tool or method or another was applied in this specific contextual environment and with what result. During OB3, levels of certainty increased rapidly and a view of the problem of accuracy of estimates in a large, international company running big and small projects became more comprehensive.

Furthermore, group meetings could be somewhat chaotic, although fortunately this was not an obstacle to gathering information and reflections, collecting observations and observing conflicts of views. Diagrams, graphs and bar charts were often used during group interviews. The issues raised were related to ethical considerations: data was never used without first informing of the scientific intention and associated regulations, and thus the information required by and related to the research project was always provided.

6.2.3 Interview/case categories in relation to interviewees and major observations

As indicated in the literature review, the number of contextual factors could be almost limitless. However during the inductive reasoning process used in Chapter 5, a list of dimensions evolved on the basis of “what was said”. They reflected the major aspects of the projects’ contextual environment that were raised and dimensioned within the axial coding process.

Understanding relationships between sources of data, the examples provided, cases, contextual dimensions and the tools discussed is fundamental to the development of the framework. Thus the factors captured in Table 27 built up the borders of the framework’s contextual dimensioning process. The table relates data gathered, major observations and interviewed cases to the dimensions – interview/case categories – previously presented in Table 17 and updated after S1, A4, K3 and OB3.

ID	Interview/case categories – dimensions	Major data sources										
		P1	M1	S3	R1	OB1	K1	OB2	S1	A4	K3	OB3
1	Expert interview	x	x				x				x	
2	Industrial sector (industries together)	x	x	x		x					x	x
3	IT and service sector (together)	x	x				x	x	x			x
4	Public and education sector (together)		x	x	x			x	x	x		
5	Internal projects (internal project sponsor)	x			x	x	x	x				x
6	External projects (external project sponsor)	x	x	x		x	x	x	x	x	x	
7	Traditional PM approach		x	x	x	x	x	x	x	x	x	x
8	Dynamic/agile PM approach	x						x				x
9	International projects			x		x		x	x	x	x	x
10	Small organizations and projects	x	x			x	x	x		x		x
11	Large organizations and projects	x	x	x		x	x	x	x		x	x
12	Single-project work environment (team members work on one project)	x	x		x	x	x			x		x
13	Multi-project-assignments work environment			x		x	x	x	x		x	x

Table 27 Contextual dimensions observed and the major data sources

6.2.4 Findings

Introduction

As presented in Figure 29, this research project has set itself five interdependent objectives. These lend themselves to a logical and sequential form of presentation. The first one is concerned with the causes of underestimation or overestimation. The second one is a further development of the conclusions thus reached and becomes an analysis which aims to formulate a framework for the more realistic estimation process. The third objective is concerned with investigating whether an increase in knowledge is always supportive to increased accuracy of estimation. The fourth draws conclusions from the previous ones and the pilot study and indicates the justification for changes to concepts and views concerning BM. The fifth and final objective is concerned with establishing whether one should focus effort on increasing the accuracy of estimates or on managing such lack of accuracy instead.

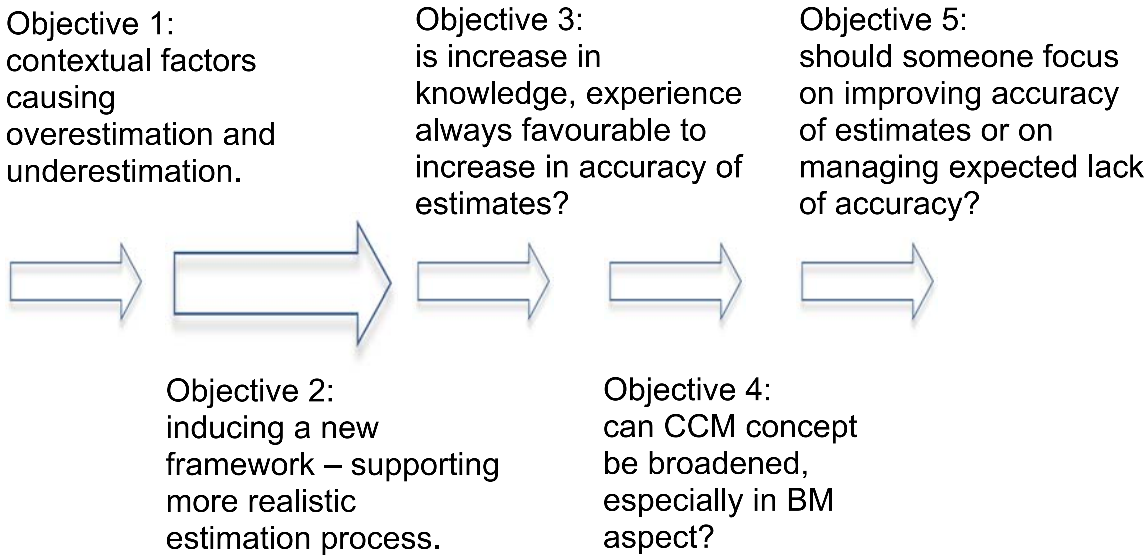

Figure 29 Sequence of research project objectives presentation

Conceptual network and dependencies between categories and subcategories

These five objectives are supported by two induced in Atlas.ti networks. Figure 30 depicts the very detailed conceptual network. It also shows types of relations between concepts. The complexity of this particular network increased during the inductive iterations. Nevertheless, it depicts clusters of concepts and codes which led to a second, more ordered, categorized and subcategorized network. As a result, Figure 31 depicts the perceived dependencies between categories and subcategories. It was achieved as an output of the axial coding process. However, because it is more detailed, the conceptual network is more effective as a basis for drawing conclusions, especially in relation to the tools within the framework.

The axial coding process could be regarded as the simplification and categorization of the conceptual network into a more readable form. It identified the existence of category "C. – PM environment context". This category and its subcategories were not linked to the axial network depicted in Figure 31 since it serves the contextual dimensioning of the findings in the development of the framework, supporting discussion of what tools should be applied and where.

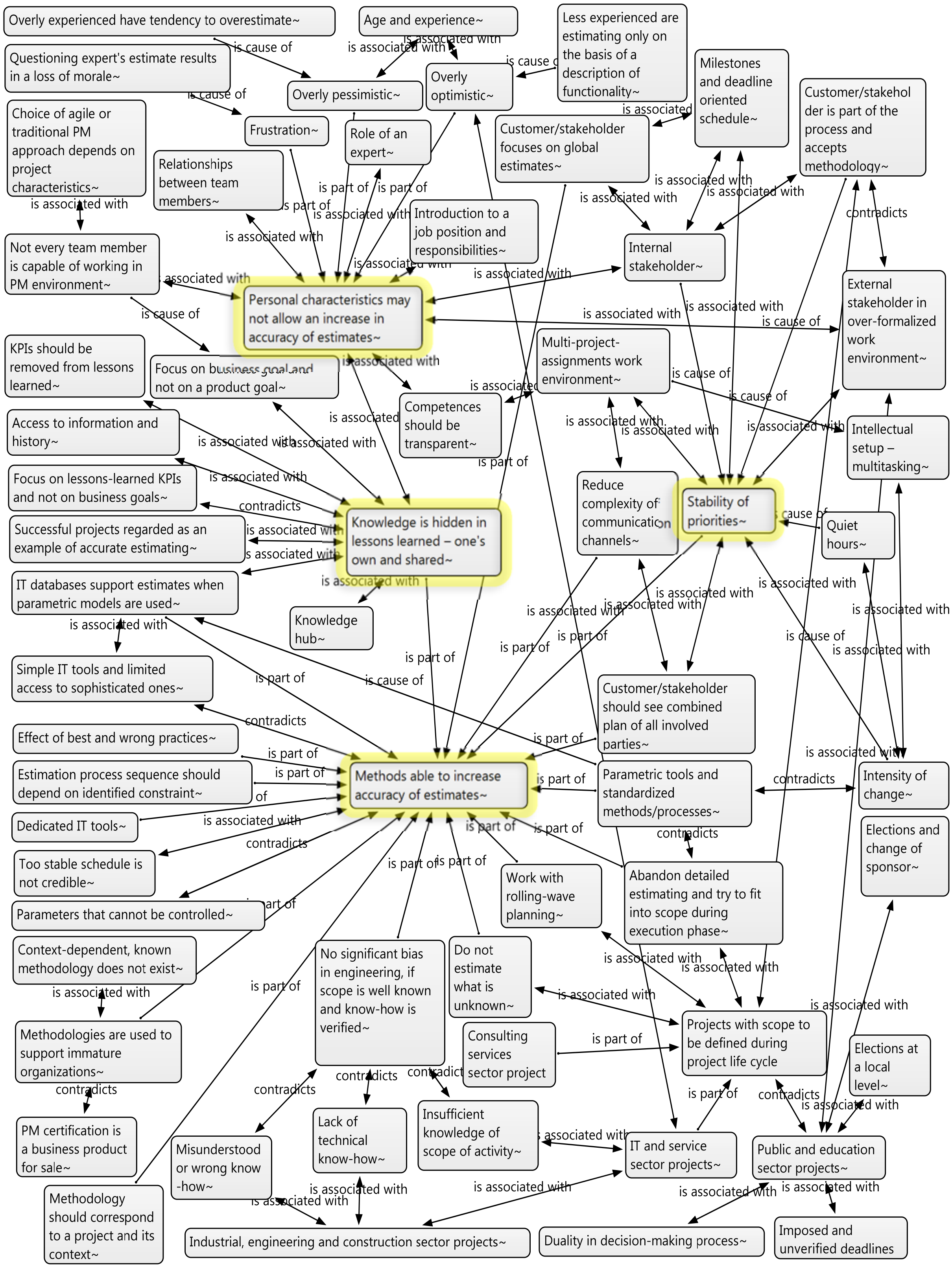

Figure 30 Codes and concepts within conceptual network

In Figure 31, the central category is "C. – Methods able to increase accuracy of estimates". This became the subject of a selective coding approach. Thus, in the course of the research process it branched into new categories and subcategories and developed pieces of information helpful in building the framework. The open structure and generality of axial coding allow this process to be readily adopted by others and its development continued. Nevertheless, tools and methods are visible in the detailed presentation in Figure 30. Sometimes they are directly supported by a high level of significance, and sometimes by reasoned argument or the quality of the sample cases used.

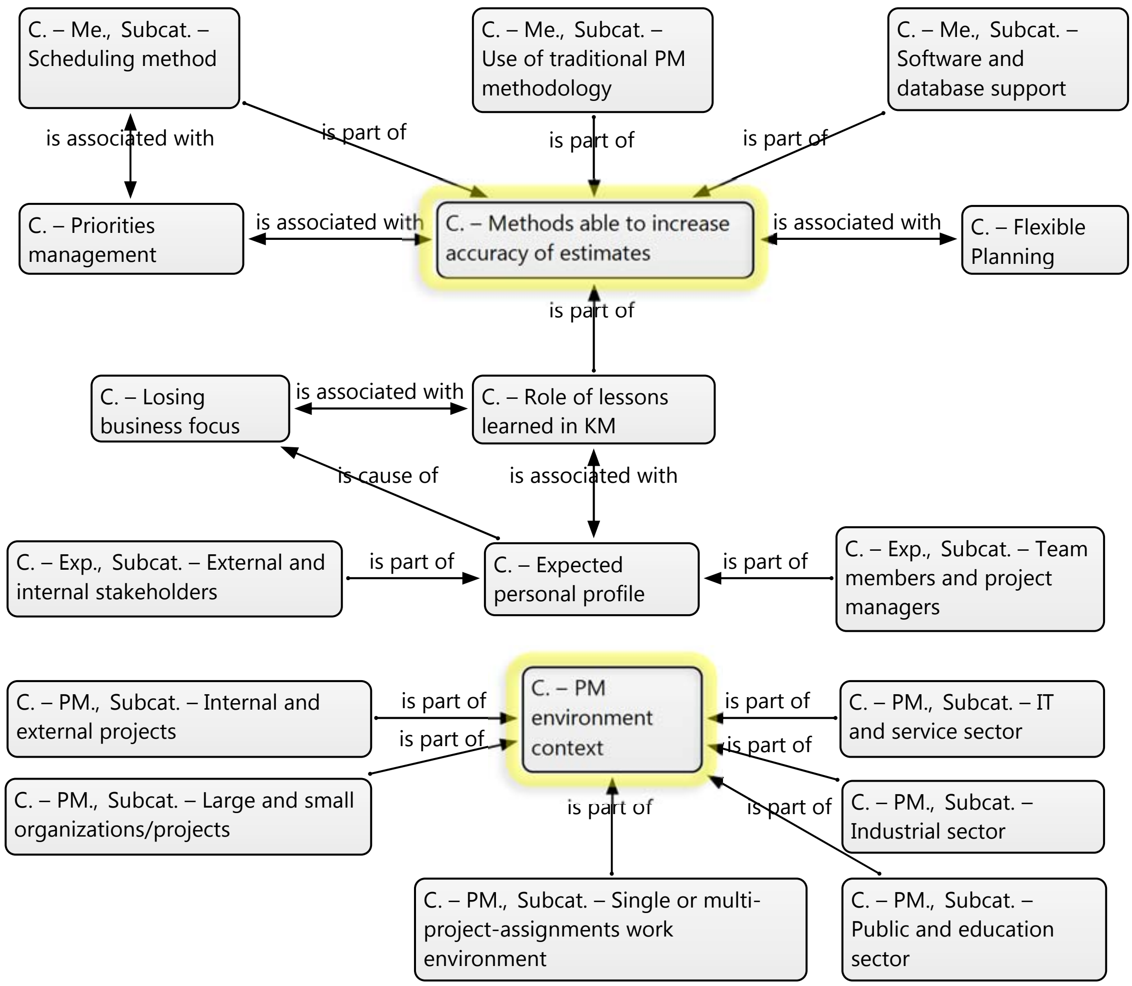

Figure 31 Axial dependencies between categories and subcategories within contextual PM environment

6.3 First objective – contextual factors causing underestimation and overestimation

6.3.1 Introduction

Chapter 5 allowed causes of overestimation or underestimation to be identified. The data collected has demonstrated that both overestimation and underestimation are possible. What is even more interesting, those respondents who were less aware of CCM concepts more often indicated underestimations.

Two concepts depicted in Figure 30, “Overly optimistic” and “Overly pessimistic”, became clusters of knowledge describing the phenomena of underestimation or overestimation. They both belong to the subcategory of “C. – Expected personal profile”. It should be noted that although they play a major role, the discussion of these phenomena does not only take place there. Many other concepts also directly or indirectly address the subject. The following sections attempt to report causes of underestimation and overestimation.

6.3.2 Major causes for underestimation

Too much optimism

Expert P1 directly pointed to being overly optimistic as a cause of underestimation. He also provided input which directly claimed causal dependency between being overly optimistic and underestimation. On the basis of his experience, he generalized and said:

“Being overly optimistic is causing underestimation.”

Practitioner S1 provided a similar direct explanation:

“If you are an optimistic person you are less likely to overestimate.”

An additional relationship – between low levels of experience and optimism – was presented by A4:

“I was, let’s say, happy: let’s do this, we will manage this, we will have success. All of a sudden, as time went by, reality has struck me quite a lot.”

It seems feasible that the connection between lower levels of experience, optimism and planning processes may imply multiple underestimations. After pointing to low levels of experience, A4 continued:

“Yes, at the beginning of the project, certainly at the beginning of the project, due to limited knowledge of scope I have had quite a lot of situations where I underestimated.”

Optimism may be a result of many things. Some of them, such as inexperience and youth, were raised and discussed further. Some of them remained unidentified. The overall conclusion is that being overly optimistic may, indeed, induce bias in the estimation process.

Too reliant on the technical aspects of the project scope

Project team members frequently encounter problems in relation to know-how and especially the focus placed on technical knowledge, especially in engineering. P1 extends this issue and suggests that being too technical and/or oriented to key performance measures may result in loss of business focus, as discussed in Section 5.2. In his view:

“They ignore additional workload not related to technical issues.”

He explained that customers and stakeholders may “look” through a paradigm that is different to the technical one that engineers often use. This found additional confirmation in the OB2 observation. One may complete a technical deliverable but not actually undertake all the activities necessary to achieve a more long-term business goal. Thus, on completion there may be a need for corrections to address this which result in an interpretation of the project having been underestimated.

Age related to experience

A4 indicated a dependency between low levels of experience and optimism. This view was shared by expert M1 and directly linked to youth. Several times he supported this with cases showing a reason for underestimation. He referred here to having fun, looking for a challenge, being young, brave. M1 used an interesting comparison:

"I could support it by showing some data from an insurance company – insurance for young drivers ..."

A similar view was confirmed by observation OB2. This suggests that, a project team may incorporate a balanced mix of ages.

Multi-project work

Uncontrolled multitasking and work characterized by the sharing of resources may result in underestimation being observed. This view was confirmed by expert K1. During a project's execution phase, such work conditions may decrease efficiency. Multi-project work may result in underestimations. Similarly, expert K3 perceived the complexity of large multi-project-oriented organizations as a contextual factor which could result in underestimation. She considered this as being "too much" when compared with a workload related to other responsibilities:

"Among other problems, you also have to coordinate different internal departments."

To clarify: her original, properly estimated and baselined schedules were regarded as having been underestimated due to other contractors arriving too late. Information about contractors' availability was not accessible at the correct juncture. This was as a result of having a limited view across all relevant schedules, which led to failures of communication and compromised decision-making process.

Public sector unlike other identified sectors

Input provided by the data collected revealed two characteristics of the public and education sector. On the one hand it is characterized by underestimation. On the other hand, it often has confined opportunities to analyse and improve the accuracy of estimates. Primarily, this was due to minimal use of available PM best practices and a limited know-how of PMMs. If this sector was to be better supported by PM practices, would the problem of underestimations be solved and are these characteristics independent of one another? Unfortunately, a case of such a "well supported" project was not identified.

6.3.3 Major causes for overestimation

Too much pessimism, being afraid

According to practitioner S1, this type of *a posteriori*-reasoning process appeared in eighty percent of the cases that he observed and thus led to overestimation. He pointed to pessimism as a direct cause:

> *"When I find a more pessimistic person, she or he will be more likely to overestimate."*

This view was sustained by expert M1 as he confirmed pessimism as an underlying motivational factor. He said:

> *"One of the factors is what would be the consequences for the person if they didn't bring the work in on time."*

Expert P1 pointed succinctly and precisely to pessimism:

> *"Being overly pessimistic causes overestimation."*

Observation OB2 delivered a similar view but from a slightly wider perspective. It also took into account the periodic evaluation of an employee:

> *"Periodic evaluation of an employee may result in being overly pessimistic. It could be an annual evaluation or any other of similar character. It is not necessarily related to a particular project. It is, rather, a problem related to organizational culture."*

The view revealed within OB2 was sustained by expert K1:

> *"Pessimism and optimism may be induced by a company's practices."*

Finally, M1 pointed to the possibility of a penalty as a potential motivation to overestimate:

"If the consequences are very high, let's say a high penalty, the estimate is associated with higher risk."

They all acknowledged and justified the view that pessimism may lead to overestimation. However, it is not visible in all cases. This issue is analysed further in the account of the fourth objective in Section 6.6.

Possibility and lack of verification

When asked about key factors leading to overestimation, expert K1 replied shortly and pointed to a failure of discipline:

"Certainly possibility – that this practice is allowed."

He explained this through the lack of verification and lack of access to experts or any other more fixed points of reference. A similar explanation was provided by practitioner R1. "Tolerance", as he described it, was visible in projects undertaken on an academic campus. He pointed to a lack of control. R1 said:

"It is more that, if they think that they will accomplish something in two or three days, then they will say that they can do it in a week. There is some tolerance there."

A4 raised an issue which reinforces the effect of lack of discipline. The concept "Best, wrong practices effect" explains that some practices, depending on whether they are tolerated or accepted, can accelerate things to either positive or destructive effect. With some emotion, A4 said:

"It is like a sort of wheel which can travel in either direction: it is only a question of which way."

Overly experienced

Expert M1 indicated this problem as a situation in which there was some "history":

"So, of course, people are not getting exactly to that point very often and they want some contingency in their estimation."

The view of M1 was indirectly shared by P1. He recognized that being overly experienced was a risk and was something that should be taken under control and treated via contingency planning. Similar input was confirmed by observations OB2 and OB3. It would seem that there is some level of experience that is "just right". Being over- or under-experienced may affect the accuracy of estimates. This problem is elaborated upon further in reviewing the third objective in Section 6.5.

External uncontrollable, unpredictable factors

It should be noted that, alongside overestimation, external and uncontrolled factors may also result in underestimation. This was indicated by expert K3. The researcher decided to assign "Uncontrollable factors" to overestimation phenomena since the data collected and the pilot study both indicated that a proactive approach towards this problem resulted in initial overestimates. To explain, proactive indicates the planning phase while reactive points to the project execution phase. With this in mind, expert M1 again introduced his input to the understanding of overestimation phenomena:

"Other things are dependent on so many external parameters that cannot be controlled so we have to take this risk into account."

For practitioner S3, one such external parameter could be a local political election and thus a potential change of sponsor. On another front, OB2 points to external factors related to people's personal/private lives. This issue was not investigated in any great detail but respondents addressed various aspects related to family, personal relations, lifestyle, and even belief. Practitioner S1 considered individual behaviour as being influenced by many factors, and not only those associated with PM-related work. In his view, it makes behavioural patterns potentially unpredictable:

"Again predictability, because predictability also depends on personality. When I find a more pessimistic person she or he will be more likely to overestimate."

6.3.4 Conclusion

During the project a lot has been learnt. It appeared that the reasons behind inaccurate estimates may be endless. Firstly, they were defined by the simultaneous existence within a single project of factors causing underestimation or overestimation, both groups of elements pulling or pushing estimates in different directions and acting with different intensities. If they both affect the schedule then it may become uncontrollable. Thus, a decrease in the number of underestimations or overestimations increases the overall project stability.

Confirming the simultaneous presence of estimation bias duality, i.e. underestimation and overestimation phenomena being seen in the same project, should encourage us to stop regarding the problem of inaccurate estimation simply from the perspective of inflated activities or safety margin management. Indeed, the present paradigm of often overestimated projects should be shifted more toward the problem of stability of the estimation process.

The researcher does not assume that the identified causes of underestimation or overestimation represent a comprehensive list. It was, rather, the beginning of the findings reporting process. The major goal was the induction of a new framework to allow an increase in the accuracy of estimates to be achieved. This in-depth analysis of a contextualised, induced set of tools takes place in the following sections. There, the understanding of the causes of a lack of stability in the estimation process is deepened.

6.4 Second objective – emergence of the new framework

6.4.1 Introduction

This section is dedicated to the presentation of the practices, tools and techniques which are recommended as enabling a potential improvement in the accuracy of estimates. These major findings are supported by the opinions of experts, by observations, and by practitioners' reflections. The researcher does not attempt to judge whether a particular technique is more or less important in this regard. Rather, he creates a starting point for further research investigation. The focus is on determining in which contextual situations the given methods should be applied or avoided.

In the sections that follow, the researcher starts to use codes and concepts in order to induce the framework's tools. He sometimes adjusts concepts' labels to make them more readable within the subsequent tabularized presentation of the framework. In addition, the framework is supported with additional, practical descriptions of know-how to apply, where ideas for a scheme of framework implementation are presented.

6.4.2 "C. – Priorities management" category

"C. – Priorities management" category was built up from the four codes and concepts listed in Table 28. They all remain closely associated within the conceptual network with the "Multi-project-assignments work environment" concept, which is part of the "C. – PM environment context" category. Although the researcher formulated the "C. – Priorities management" category relatively late within the inductive reasoning process, it soon became a highly significant and prominent group of methods. At the outset, its concepts were placed within the "C. – Methods able to increase accuracy of estimates" category, but ultimately they constituted a totally new one. Each of the codes listed in Table 28 contains ideas which could be considered as examples of applicable tools.

Category	Codes and concepts
C. – Priorities management	Intellectual setup – multitasking
	Intensity of change
	Quiet hours
	Stability of priorities

Table 28 "C. – Priorities management" category

Manage priorities in micro and macro-scale

The "Stability of priorities" concept was invoked by R1, K1, A4, K3, S3 and observed within OB2 and OB3. Expert K1 considered it to be more a problem of micro-scale planning. He referred to small daily issues which affect the original set of estimates. He said:

"Usually it is assumed that they stay focused, but the reality is that these people receive a great amount of other, unrelated work."

In the view of K1, this unrelated work may also come from other projects or departments within the organization. Furthermore, he linked this view to uncontrolled multitasking and multi-project work environment, both factors which in his view effectively change priorities. At the same time, it is interesting that other sources regarded the same problem from a macro-scale perspective. R1, while considering success, directly recalled the influence of his manager:

"That was because he said it should be done by this date."

On the one hand, he thought in terms of priorities set at a macro-scale but, at a particular moment, he somewhat extrapolated them to the micro-scale level and said:

"I guess they have to prioritize the things that they are working on so they have space to work on projects."

R1 represented the public and education sector and rather large-scale projects. However, the same path relating to micro-scale priorities was also followed within OB2. This observation was defined by two meetings. At the first one the phenomena of problems in prioritization was registered and it was confirmed in the course of the second one:

“If project teams share large numbers of people then priorities will start to fluctuate.”

Rather than the micro-level, A4 concentrated on priorities at the macro-level. He described a typical single-project work environment where problems with priorities ruined the accuracy of estimates. He said:

“It is ironic that this was not due to my intentions, was not due to my knowledge, understanding, or being supported. No, it was because I was not in control of priorities.”

He followed up this view in a more holistic form. A4 believed that the importance placed on the macro-level priorities should be shared and sustained, and should even be a part of the PM culture. He made no exceptions here and when considering the role played by stakeholders he said:

“… they should support the milestones schedule. Yes, it would help immediately.”

The positive effect of priorities set at a macro-level was again underpinned by K3. This expert represented international, large-scale projects within the automotive industry and she was clear about the need to sustain priorities. She said:

“It is known. Maybe not everything is very detailed but you know exactly what and when it should be done.”

Further discussion revealed that within the cases she shared, priorities could not always be maintained. This was mainly due to an extensive number of stakeholders and problems with sharing usable information. K3 largely contributed to the macro-level perception of priorities. Due to her work position her view of the micro-level was rather limited.

Finally, the two years that observation OB3 lasted introduced valuable reflections when documenting this problem. OB3 was universal enough to provide observations of the phenomena discussed in industrial, IT and service sectors. One of the observations was that:

"Quite often in a discussion, and without any sign of particular concern, project managers or team members revealed that deadlines had been missed. These examples presented really vast deviations."

There was no observed correlation between these facts and broadly perceived levels of stress. Stakeholders, team members and project managers even seemed to be accustomed to such a dismissal of previously provided estimates. When carefully investigated, it appeared that the priorities used were not the most stable ones:

"The major issue was that priorities changed. They maybe did not change too often but certainly monthly, quarterly or annually."

The overall impression is that if priorities are not maintained at a macro-scale then the micro-level may also be affected. Furthermore, project context may act as an amplifier of the problem. For example, in a multi-project work environment micro prioritizing becomes more important than in a single project. However, macro prioritization seems to be equally important in both situations. Regardless of the situation, if priorities are not managed then estimates may prove inaccurate.

Changed priorities may not only be a result of conflicting projects. They may well also be induced by conflicts with priorities set by a company's functional structure. This view was provided by expert K1. His input supported the introduction to the framework of two related tools: macro- and micro-level priorities management. As depicted in the formulation of Table 34's framework matrix, they both correspond by name to the title of this section. Finally, practitioner S3 was somewhat sceptical in his view. He linked changing priorities to parameters that cannot be controlled. However, the characteristics of his project's unfavourable contextual situation do not define all potential ones.

Intellectual setup – multitasking

Setup, understood as a preparation for work, was a form of analogy to the setup found in repetitive processes, such as in manufacturing. There, setup periods separate and divide periods of production. Similarly, K1 pointed to the intellectual setup as a cause of chunking activities. In his view, this frequency may get out of control. One should therefore decrease reasons to multitask resources. However, as a part of contingency planning one should also prepare resources to be able to offer a variety of skills. Used in conjunction, these actions may help estimates to remain more accurate. According to experts, it may be even more favourable to the protection of estimates in large organizations characterized by multi-project work environment. K1 indicated that:

"It depends on the size of organization and the number of projects within it."

In addition, he supported this view with the words:

"If I have spare time and I don't have to code, I can look after the hardware."

The duality of the multitasking problem persists. It can still be considered as a means to pull changes into an available timeframe. This flexibility could be attained by having previously ensured a proper mix of competences. If not sufficiently developed, multitasking decreases the accuracy of estimates:

"… then this estimate of three days may double or even triple."

Within the conceptual network another problem associated with multitasking was the "Intensity of change" concept. This acted as an amplifier of multitasking. It was further confirmed by two OB2 meetings. They described the problem in the following way:

"Intensity of change should not only be associated with scope, schedule or budget. It may be increased by exchanging team members or changing typically associated roles."

Furthermore, perhaps due to the current difficult economic situation, they underlined the problem:

"Job rotation unfortunately increases intensity of change."

This aspect suggested that the label of the proposed best practice should be a more open and holistic one. Bearing this in mind and remembering the two sides of the multitasking "coin", the label of the best practice was formulated thus: "Prepare for and decrease reasons to use multitasking". Yet, expert K1 did demonstrate both the negative and positive effects of multitasking. On the one hand it may decrease efficiency but, on the other, it may allow use to be made of any spare timeframes.

Quiet hours

This concept was introduced by K1 and supported by K3. It was also, under this moniker, introduced directly to the framework. With a background in IT, K1 was in favour of such a method. K3 – with her international, automotive sector background in externally-oriented projects preferred to debate this idea. However, she did not dismiss it but instead constrained its application. K1 generally presented this technique as a verified one, able to protect the accuracy of estimates. He said:

"For two or three hours during a day absolute silence was required."

He was rigorous in this requirement. Expert K1 underlined that often in his projects they:

"Turned off internet communications and even telephones."

In contrast to this, K3 tended to a more precise and controlled application of this technique. On the one hand she confirmed the existence of the problem:

"I am distracted from my work by interruptions," and started to propose other similar solutions …*"If someone needs such time then they may simply work at home."*

Finally, as an expert she began, step-by-step, to limit its contextual applicability:

"What if I should miss valuable information? What if the customer should call? The customer is unlikely to make use of our quiet hours. The quiet hour principle cannot be shared by all stakeholders."

This view is certainly dependent on her contextual background. A multi-project work environment, external and large projects, and higher numbers of stakeholders all tend to limit its application. In addition, it was clearly reflected in her overall data and in the cases she presented, she expected a high level and quality of communication in an organization.

6.4.3 "C. – Me., Subcat. – Scheduling method" subcategory

The introduction of this subcategory was triggered by conceptual network connections to a method previously discussed. The subcategory was built up around the four codes and concepts listed in Table 29. Among these, "Milestones and deadline oriented schedule" is associated with the "Stability of priorities" concept previously discussed. The subcategory also remains related to a previously discussed category at the axial coding level. Logically, therefore, this is a natural path by which to continue discussion of other tools and techniques.

Subcategory	Codes and concepts
C. – Me., Subcat. – Scheduling method	Estimation process sequence should depend on identified constraint
	Milestones and deadline oriented schedule
	Parametric tools and standardized methods/processes
	Too stable schedule is not credible

Table 29 "C. – Me., Subcat. – Scheduling method" subcategory

Focus on macro estimates not on a whole detailed schedule

An idea to place focus on macro estimates was developed on the basis of the "Milestones and deadline oriented schedule" concept. It was broadly discussed by P1, R1, S1, A4 and K3. It contains observations from OB1 and OB2. From the perspective of the whole subcategory, it was also supported by M1 and OB3.

Expert P1 identified the existence of two layers in the estimation process. One dedicated to milestones and the second dedicated to individual activities. According to him, the first, macro view is more important because it is also visible to the project's main stakeholders:

"Note that stakeholders like the customer do not necessarily go into individual estimates – they are more interested in the overall situation."

Consequently, he continues:

"We therefore set general estimates and inside of these we work as we see fit."

He simply indicated that estimated activities between milestones are less visible to stakeholders. This dual macro-milestones/micro-activities perspective was somewhat similar to an earlier discussion of the influence of priorities. In this case, though, the attention paid to accuracy of estimates was shifted towards a view based on macro-milestones. When this topic was discussed with R1, representing the public and education sector, he also immediately pointed out that his manager was the person setting milestones/deadlines. Again, not to mislead, R1 was not unhappy with this situation as he considered his manager to be an expert in the field. Observation OB1, which represented the group of PM practitioners, offered a similar view to R1's:

"It could be said that deadlines have dual characteristics. One of these is their credibility, which relates to that of the manager who is promoting the deadline."

A second characteristic identified within OB1 confirmed the approach of expert P1. This particularly related to the priorities applied to the macro-scale. These, in addition, added a supportive "macro-effect" to the estimates at the micro-level:

"Second is deadline power. If this is shown to be weak then priorities will change and bias will be observed on activities previously estimated."

Observation OB1 introduced more insight into the relationship between the power of priorities and the schedule of milestones. There, attendees mainly complained and argued that milestones are “undermined” by other projects as well as organizations’ functional structures. They held this macro perspective in conjunction to priorities management:

“Perception or power of the deadline may fluctuate. If the power of the deadline decreases then the priorities of the person responsible will start to fluctuate. It will imply the necessity to re-estimate or re-schedule.”

Observation OB2 was conducted in an IT company which makes use of agile techniques. There, just as in the public or industrial sectors, the problem confirmed itself. They expressed their view in the following way:

“Focusing on milestones helps to reduce inaccurate estimates. This is mainly a statistical result since the estimation process is less detailed. Nevertheless, the question is whether this detailed estimation process is always necessary?”

Once again, the importance of the macro view was confirmed by IT practitioner S1. When referring to a large-scale project lasting three years he said:

“This is a schedule based on milestones but from there we just drive the activities.”

A4 and expert K3 also followed a similar way of thinking. They recognized and promoted the macro-level as vital to the accuracy of estimates. A4 addressed this problem very spontaneously:

“Milestones related to priority management, in this case, I think should be almost holy ones ... If there is a problem with the stability of estimates then at least one factor would be taken away.”

K3 viewed this approach as offering the ultimate solution to the problem of inaccurate estimates. In her view if other standards are applied and know-how is present then:

"Overestimation does not take place. It may happen that some milestones will move."

Placing focus on milestones may have various effects on the accuracy of estimates. Estimating milestones alone implies a reduction in work effort and limits the number of questions related to estimates. Less bias is observed, as a matter of course. This is not only a statistical implication. Placing focus on milestones also frees time which may be committed toward improvement of a particular element of estimation that is seen as key. It decreases volatility and protects project resources against the impact of other unplanned obligations.

Discussion of this framework technique was well founded. The problem was identified from the very beginning of the inductive process and during the research its clear division into macro and micro views became visible. Milestones, as the name indicates, correspond to a macro-level perspective. Micro means that if macro estimates were set well then micro would at least have less bias. This micro may also mean some less important, intermediate milestones or simply just activities. This introduction to the framework techniques was named identically to the title of this section.

Standardize chunks of work and apply parametric-based tools

As listed in Table 29, the concept "Parametric tools and standardized methods/processes" calls for the application of more process-oriented management. The definition of project, as discussed in Section 1.2.2, does not make any reference at all to the uniqueness of any one instance. If some practices could be quantified into more predictable chunks of work, why should it not also be applied or at least recognized as possible in PM? This thinking process was mainly supported by experts P1, M1, K1 and K3. It was also confirmed within observation OB3. K3 anticipated that these chunks of work would be well defined. In such situations, she did not expect deviation in estimates to occur. This expert was strongly technology- and industry-oriented. She often backed up her view with similar statements to:

"Specification defines what types of tests should be applied. Also how many should be undertaken."

P1 perceived this problem in a similar fashion. He even asserted that sometimes without having any parametric tools, known scope it is necessary to learn:

"… a different philosophy of work."

This expert thought that such an approach could be supported by information systems. With his IT background, K1 was even more in favour of such IT-backed solutions and discussed them from the perspective of functionalities, as well as in terms of the problems associated with their application:

"… which collects knowledge, categorizes it. The problem with them is that it is hard to assure their topicality."

He preferred to make use of parametric-based solutions in multi-project work environments. This multi-project contextual characteristic is again confirmed by another expert, K3. As an industrial expert she admitted that her projects are supported by repeatable, well-defined services:

"That is why this person performs tests for many different projects. There is a plan for the workload of the laboratories. These laboratories provide services to our projects."

Finally, observation OB3 also underpins the value of this technique. There the process of standardization could be observed almost everywhere:

"It was evident that they do everything to make these services as repeatable as possible. This tendency could be found in improvements to workflow and process descriptions. However, it could also be found in the layout of furniture, conference rooms or even location of parking slots."

Such an approach made projects more predictable, at least at a micro-level. Observation OB3 described this method as the practice being applied to all areas, not only those currently supporting projects. Consequently, this method was added to those provided in Table 34's framework. Discussed issue remains closely associated with IT tools. Within the conceptual network it is linked to concepts representing the use of IT and databases. However, since it is a part of a different subcategory, it is debated in a separate, dedicated section.

Indicator of problems

The “Too stable schedule is not credible” concept was first identified during observation OB2 and later confirmed by expert K3. It could not be regarded as a method for improving the accuracy of estimates. However, it has potential to become an interesting new indicator suggesting that “something is wrong” with an estimate. The whole idea arose around the assumption that although an increase in accuracy is a must, the total elimination of bias is not possible. That is why, claiming so becomes suspicious. OB2 delivered some explanations for the existence of “super-stable” projects and schedules. None of them, however, refer to the correct provision of estimates:

“It could be an indicator of having overestimated the project while working with a team that is not motivated to finish earlier.”

Or similarly:

“It could also indicate an inaccurate schedule that has been delivered without bias due to resource flexibility.”

Finally, although hard to accept as a legitimate part of PM practice:

“… maybe someone frequently updated the contractual agreement? Then differences between present baseline and actual, current state would not be visible.”

The researcher has to admit that “super-stable” schedules should be treated with suspicion, at least from the perspective of accuracy of estimates. This reflection was linked to the formulated framework in such a form and became a type of trigger indicating the need to start the process of improvement.

Align sequence of estimation process to business constraints

The method proposed in the title of this section finds its roots listed in Table 29's "Estimation process sequence should depend on identified constraint" concept. This promotes the idea that the sequence of estimation should be defined and cannot just be random. One person may start from a macro perception of milestones, resource limitations, budget or time. Others may narrow the sequence to a set of chosen activities, for example, by applying principles of CPM or CCM. On the basis of P1, S1 and K3, it was not possible to conclude with what constraint someone should start. However, on the basis of their input a common notion could be extracted: an estimating sequence must be set and followed. In the opinion of expert P1:

"Business should identify the approach toward this sequence, not its methodology."

This was the broadest perception of the problem. In fact, it was actually a conclusion formulated after having discussed PM cases related to agile techniques. There P1 assumed that:

"It may be time, work effort, scope or budget. Usually in agile it is budget. Identified constraints organize sequence."

In a more specific way, practitioner S1 briefly underlined that they look first at:

"Mostly resources."

He also indicated that:

"I always pay attention to the critical chain of the project."

Expert K3 believed that the most important constraints are related to the macro-level. Her view was strongly influenced by the contextual situation of international projects which she had observed. She said:

"Most important are milestones and time."

The short presentation provided above indicates a consistent conclusion. The sequence of the estimation process should be set with regard to identified constraints. The researcher was most impressed by the reflections provided by one particular expert, P1. His view was to set sequence of work as a response to business constraints and to follow these. The method was introduced to the framework and labelled identically to the title of this section, to emphasize the need to give an answer to the implied "question mark" around major constraints.

6.4.4 "C. – Exp., Subcat. – Team members and project managers" subcategory

Multi-project work environment contextual factor defines the connection between the already discussed "Stability of priorities" concept and the ones contained within "C. – Expected personal profile" category being composed out of the two major subcategories. One of these subcategories, discussed here and captured in Table 30, was built on many concepts of high significance. Within the conceptual network these were grouped around "Personal characteristics may not allow an increase in accuracy of estimates". Some of these concepts enrich understanding of the phenomena of underestimation and overestimation while others contain ideas of how to increase accuracy of estimates. In this section the researcher elaborates only on those inputs which addressed potential tools and methods, although all sources of collected data contributed to the subcategory described.

Subcategory	Codes and concepts
C. – Exp., Subcat. – Team members and project managers	Age and experience
	Competences should be transparent
	Overly optimistic
	Overly pessimistic
	Frustration
	Introduction to a job position and responsibilities
	Less experienced are estimating only on the basis of a description of functionality
	Not every team member is capable of working in PM environment
	Personal characteristics may not allow an increase in accuracy of estimates
	Questioning expert's estimate results in a loss of morale
	Relationships between team members
	Role of an expert
	Overly experienced have tendency to overestimate

Table 30 "C. – Exp., Subcat. – Team members and project managers" subcategory

Visualize and keep competences transparent

This proposed method for the framework was built on the "Competences should be transparent" concept which was, surprisingly, only identified towards the end of the research. This concept was mainly supported by observations OB2 and OB3. Respondents within OB3 tended to subordinate this method within a group of lean techniques. In the OB2 observation this approach was linked mainly to hard IT competences, and they insisted on making this information accessible to everyone. Both observations considered multi-project work environments. However, in OB3 this method was also used to support single, individual projects. This approach was visible almost everywhere:

"Regardless of whether in shop-floor or office areas, it was possible to spot dashboards representing names of employees, their key skills and level of competence."

This transparency of competences also extended to soft skills. At the very beginning it felt somewhat awkward, but after some time the researcher got used to having access to such information.

"What is even more interesting is that these dashboards presented both soft and hard skills."

The researcher incorporated this technique into the framework mainly due to numerous arguments collected within OB3 and its verification within lean management techniques. Multi-project situations do indeed require the means to rapidly answer the challenge of who can do things and to what level in order to preserve project estimates. Transparency helps to dynamically make use of available timeframes, as previously raised by K1. Therefore by better management of resources it assists preparation for eventual multitasking, a problem already discussed and captured within the framework.

Balance competences, experience and age of team members

This method was developed after studying several major concepts. It considers "Age and experience", "Less experienced are estimating only on the basis of a description of functionality" and "Overly experienced have tendency to overestimate". The idea, as expressed in the section's title, was backed by all of the sources of data. Within OB2, experience is related to age and estimating practices:

"Inexperienced and somewhat younger developers have a tendency to propose delivery dates that are too early."

This path was followed up by expert M1 where he was even more specific:

"I've concluded now that it was maybe not just immediately after their studies but actually connected to their age," and continued … *"I would say especially young people, especially below twenty-five, thirty – they would take more risk than others."*

This expert searched for an explanation for this phenomenon:

"They themselves are willing to give an underestimate for the job in order to have, let's say, some kind of fun: a challenge for themselves."

But does it mean that one should depend on estimations conducted only by older, and potentially more experienced, people? According to P1, this is not the case, and this expert pointed out:

"Too much experience and having faced mistakes means that they will try to estimate very safely." He continued even more cautiously …*"It addresses experience. With this experience is associated a greater risk."*

Expert K3 also confirmed this problem and said:

"Probably I would add some time. From his or her experience a person knows that not everything will function as it was planned."

IT practitioner S1, while considering the individual person, instead assigned importance to the experience aspect:

"It is really a human factor so it is a human factor. I do not think that we can formalize, that we can make it better. But it all depends on your experience."

Expert M1 gave an indirect explanation to the problem being discussed:

"Eventually we get those experienced professionals to have enough experience to conduct estimations."

Having seen both the duality of age as a function, and the duality of experience as a function, the researcher arrived at the conclusion that a simple statement to the effect of "be more experienced" may be wrong, at least from the perspective of maintaining accurate estimates. Logically thinking, to keep the whole process under control, the team should be "balanced" somehow. Is it really possible that an expert will welcome cooperation with a newbie and consider this as helpful to the estimation process? Perhaps he or she should. Due to its wide coverage of contextual aspects and the insight of respondents, the method was considered as one that is generally applicable within the framework. This problem is further investigated in the response to the third objective in Section 6.5.

Place experts in each major area to provide point of reference

This tool within the framework was developed on the basis of the "Role of an expert" concept. It was backed mainly by expert K1, practitioners A4, S1, R1, and by observation OB2. In OB2, PM experts were considered as those who provide points of reference, i.e. estimate value, provide an assessment that could be compared to other sources of estimates. How could someone identify bias or interpret deviations while not having a stable point of reference – key experts?

K1 viewed the presence of experts from a slightly different perspective. He considered them as a factor which directly increases the stability and accuracy of estimates. He said:

"Awareness of verification implies a decrease of instability in the estimation process, regardless of whether in pessimistic or optimistic direction."

This could be regarded as an increase in "discipline", an element of quality assurance best practice. Similarly, R1 underlined the value of experts in both the planning and execution phases and pointed here to larger organizations. A4 aimed for direct improvement of the estimation process by saying:

"… of significant importance to accuracy of estimates is the experience of the person who helps you …"

As proposed in the title of this section, this method helps to stabilize points of reference to identify value of deviations. Thus it may be used as a technique for validating conclusions contained within a project's lessons learned. The presence of an expert also may bring an additional discipline to a team, and his/her direct help in estimation may improve team morale.

6.4.5 "C. – Exp., Subcat. – External and internal stakeholders" subcategory

This was the second of the two subcategories related to personal profile. In contrast to the subcategory just described, this one is focused on the significance of stakeholders. Within the conceptual network this group did not have any specific central point. Its concepts tend to maintain a variety of relationships to many different parts of the network. These network dependencies helped in understanding and identifying new ideas and methods with the potential to improve the accuracy of estimates.

Subcategory	Codes and concepts
C. – Exp., Subcat. – External and internal stakeholders	Customer/stakeholder focuses on global estimates
	Customer/stakeholder is part of the process and accepts methodology
	Customer/stakeholder should see combined plan of all involved parties
	External stakeholder in over-formalized work environment
	Internal stakeholder

Table 31 "C. – Exp., Subcat. – External and internal stakeholders" subcategory

Customer/stakeholder should see combined plan of all involved parties and accept methodology

This framework's method was introduced by K3, S3 and M1. In K3's case, what started as a minor but comfortable overestimation was later observed as a serious underestimation, largely due to a lack of coordination between many separate contractors. At the beginning, it seemed that they had plenty of time but suddenly the scope of schedules seemed to have been underestimated. Her large projects involved a number of different stakeholders and external companies. It proved impossible to coordinate them all because sometimes a subcontractor emerged too late. Thus the execution of the schedules failed in part because in the planning phase it was not possible to analyse all of them together. She said:

> *"Each one does timings for itself and it is only a result of subcontractors' goodwill that they exchange this information."*

The customer, and main sponsor, concentrated on delegation rather than coordination. K3 made the point:

"It is the customer who divides procurement amongst different subcontractors. It is we who depend on these subcontractors."

Some "goodwill" filled the gap when coordination failed. As sponsor, the customer did not do his or her job on these international, large-scale projects. Again, K3 made the point:

"They have no management systems that would coordinate it."

Expert M1 addressed the problem mainly within the "External stakeholder in over-formalized work environment" concept. He concentrated there on the stakeholders' level of engagement in a project as a way to improve accuracy of estimates. Engagement in this context meant having access to a project's data and following the PM methodology. He insisted on:

"... really getting high-level people involved."

And, furthermore, within the same case description:

"… you have to communicate with stakeholders."

Similarly, practitioner S3 pointed to the lack of stakeholder participation. It seemed to be less important whether a particular methodology, set of tools, or developed framework was in use. Regardless of what was in use, if accepted by stakeholders it should be followed until the next collectively agreed shift of approach occurred. In the case of S3, it could be said that his public, international project's lack of a collectively accepted method of coordination also resulted in degradation in the application of other PM practices.

This topic had a high density level within the conceptual network. To increase accuracy of estimates, the transparency of associated schedules should be assured, in both their planning and communication. Especially in the context of a multi-project work environment and increased complexity, sets of tools and methods should be shared and accepted. The problems described were found to have general applicability, for example, in both public and industrial sectors.

6.4.6 Analysis of "C. – Role of lessons learned in KM" category

All observations, experts and practitioners made reference to this category. The researcher could not make use of all of their significant quotations within this work. Overall, its significance level was the second highest among all the categories. It is only possible to discuss here the most valuable tools and methods with potential to increase the accuracy of estimates. The conceptual network corresponding to this category was built up around the "Knowledge is hidden in lessons learned – one's own and shared" concept.

Category	Codes and concepts
C. – Role of lessons learned in KM	Access to information and history
	Knowledge hub
	Knowledge is hidden in lessons learned – one's own and shared
	Lack of technical know-how
	Misunderstood or wrong know-how
	No significant bias in engineering, if scope is well known and know-how is verified
	Insufficient knowledge of scope of activity
	PM certification is a business product for sale
	Successful projects regarded as an example of accurate estimating

Table 32 "C. – Role of lessons learned in KM" category

Develop lessons learned knowledge hubs and assure access to them

This method represents a group of tools. It was built mainly around the first three concepts from Table 32, essentially, having access to information, knowing where it is located, and ensuring that knowledge is developed. The framework method presented may make use of individuals, experts or corresponding software solutions and other creative ideas. K1 said:

"Knowledge comes from the head of a person or from some system that collects knowledge and codes it."

According to K1 and R1, this exchange of information is vital. K1 said that a team member must be informed about where to find knowledge:

"In what direction should one go? Who possesses this knowledge?"

K1 suggested that even the location of this knowledge hub must be made known to project teams. When thinking of knowledge hubs, he added:

"The person himself may not know but he knows who knows."

Expert K3 underlined the value of periodic meetings to collect lessons learned, and to discuss models of knowledge storage and sharing. The methods proposed may be valuable not only to those already on projects but also to new team members. She provided examples of best practices in KM and directly underlined that, in her projects, lessons learned:

"… are certainly available."

A4 related access to lessons learned directly to the accuracy of estimates and priorities being set early on. He explained:

"I would say that at the beginning of the research project I had no idea what I would face. Actually, the majority of it was quite new to me."

M1 extended understanding of knowledge hubs even to sources external to the project environment. Sources of knowledge could be identified everywhere. M1 said:

"… of course, articles of academic level should be read and written. Sometimes conferences, speeches, things like this."

S1 recognized each project mistake as an opportunity to learn rather than to punish. S1 promoted an approach aimed at increasing knowledge levels:

“I try to understand how it happened. Actually, I should have understood by that time what we did correctly and what we did wrong.”

Experts P1 and K3 also concentrated on the role of KPIs in this area. They both remained sceptical and did not recognize lessons learned as a place for reporting performance indicators. P1 was afraid of losing business focus. He claimed that KPIs may pull focus away from business goals. Thus, a project may fulfil its KPIs but fail to assure business change. One expert described a sample case and concluded:

“As a result there may be a risk of having to run additional, correcting projects.”

Similarly, K3 recognized lessons learned primarily as a place to collect business reflections rather than sets of KPIs. She indicated that lessons learned were focused on PM characteristics and should not be used as a place to store KPIs:

“These are not process-type activities. It rather should focus on practices and skills.”

On the other hand, questions still remain. Do KPIs necessarily draw attention away from projects’ business goals or are the KPIs that projects use poorly chosen?

In conclusion, KM supported by knowledge hubs may increase the accuracy of estimates. Systems to collect, store, share and review data should be defined. A culture that promotes learning as opposed to punishment should be maintained. Points of reference and experts to properly identify and interpret bias should be identified. Other concepts contained within this category strengthened this view. Surprisingly, there was no conceptual dependency identified between PM certifications products and increases in the accuracy of estimates.

The technique proposed in the title of this section may be supported by other complementary tools. Subcategory “C. – Exp., Subcat. – Team members and project managers” includes the “Introduction to a job position and responsibilities” concept. This is one that, in the view of practitioner S1, may help to address the problems already discussed in relation to the “Age and experience” concept. A similar view was provided by expert A4. According to him, lessons learned and knowledge hubs may support such introductions. This became another argument to suggest that the synergistic effect of the framework may be conditioned by the broader implementation of its techniques.

The final issue considered the “Successful projects regarded as an example of accurate estimating” concept. In some ways this could be perceived as a risk which might bias lessons learned. A successful project typically means a satisfied customer. This view was shared by K3. The problem is that being successful should also be conditioned by accurate estimates. However, success could also be defined as an overestimated project that is completed comfortably, in which case the conclusions of a lessons learned exercise could be misleading. It seems that this problem may be eased by the points of reference technique already introduced to the framework (Table 34).

6.4.7 “C. – Methods able to increase accuracy of estimates” category as a group of techniques

This category was assigned the same name as the corresponding concept within the conceptual network. During the axial coding process it productively branched into new subcategories. This was mainly a result of an increase in the significance level of individual concepts. Subcategories related to the scheduling method were discussed in relation to priorities management. Two final ones, captured in Table 33, will be elaborated jointly. The concepts present in Table 33 are used to incorporate three additional methods into the framework.

Category and subcategories	Codes and concepts
C. – Methods able to increase accuracy of estimates C. – Me., Subcat. – software and database support C. – Me., Subcat. – use of traditional PM methodology	Effect of best and wrong practices
	Reduce complexity of communication channels
	Dedicated IT tools (functionalities are consistent with deliverables and project context)
	IT databases support estimates when parametric models are used (considered only as data sources)
	Methodologies are used to support immature organizations
	Methodology should correspond to a project and its context
	Methods able to increase accuracy of estimates
	Simple IT tools and limited access to sophisticated ones

Table 33 "C. – Methods able to increase accuracy of estimates" category and branched subcategories

Reduce and minimize complexity and number of communication channels

The "Reduce complexity of communication channels" method became evident based on the expertise of K3. She complained about poor communication in regards to large, international and multi-project cases. She addressed it as a problem that affects estimates that were seen as correct at the outset. K3 considered that communication channels had not been coordinated:

"It would be easier if there was somebody coordinating it from a timing perspective."

To illustrate the problem of communication channels that were either not functioning or demonstrated too much lag, she admitted that:

"Some information emerges from the customer. In a large part, this information is informal."

Informal methods were used to back up the standard ones. S3 approached the topic in a similar manner. There, division in the decision-making process affected communication channels and, more generally, the quality of decisions taken. OB3 provided a view of the same problem by standardizing chunks of work which was incorporated into the framework. The concept remained linked within the conceptual network to ones that describe a customer/stakeholder. There, another argument pertaining to communication channels could be found. A4 said:

> *"Frequent review of work is helpful. Interaction helps. I cannot define the frequency but it helps to maintain communication."*

A similar view was taken with regard to the management of stakeholders. OB2 provided another argument in support of a reduction in the number of communication channels. They applied a hub and node concept. The project manager did not maintain contact with each individual team member, but instead worked with team leaders who mediated communications with those within the teams. In this way, they promoted the idea of ownership regardless of whether it referred to change requests, work packages or risk identification, resulting in the simplification and reduction in number of communication channels.

IT tools should adjust to project and work environment context

In the majority of cases discussed, the use of IT tools was considered as influential on the accuracy of estimates. The word "influence" is used for good reason as IT could not only improve but also worsen accuracy. Expert K3 seemed to be rather disappointed with the software support available. She said:

> *"I consider the currently available system solutions and/or IT as ones having a large influence on a project's delay."*

In contrast, A4 was very positive about the existence of such solutions. When he was asked about IT support he replied thus:

> *"When I think of the number of mistakes that I have avoided due to application of this software, simple human mistakes. In that way, this IT tool increased the stability of the estimates. It was dedicated to this type of project."*

This statement resulted in a reanalysis of previous transcripts and enabled the common pattern to be identified. Similarly, S3 expected to have customized systems rather than standard ones. He even admitted that he used to plan with a sort of “text file”. IT tools should be dedicated to, and compatible with, the context of appropriate project exemplars. On his public sector project, R1 seemed to be slightly equivocal about his software support:

“Maybe it is not as comprehensive as it should be or is not sophisticated as it should be.”

Should someone use standard tools or dedicated ones? Adopting an approach based on dedicated tools certainly cannot imply the development of an IT solution for each individual project: it would almost certainly be too costly. The researcher can confirm two findings. Users seem to be unhappy with current levels of software support due to limited contextual compatibility. They complain that software should also better support project deliverables, as well as project and work environment contexts. This idea defines a common pattern that should be considered as generally applicable to the framework: IT tools should be compatible with project and work environment contexts.

Apply brand-named methodologies

This method may be of surprise, especially when one considers the purpose of this research project and its working assumptions. Thus, the attempt to improve accuracy of estimates was built on direct connections between techniques and the project’s context, without any intermediating and branded methodology. On the other hand, the research process indicated the need for education in the field of PMMs. In a way it indirectly addressed PM methodological brands. However, expert P1 preferred to think in terms of tools and techniques and did not consider methodologies to be helpful in his practice but he admitted:

“Methodologies are helpful in immature organizations because they have their deficiencies, yes?”

S3, who represented PM in a rather immature organization, expected methodological support in order that they could start to develop their own standards. He was very unhappy with the current situation. This practitioner underlined a number of times that he would, at least, like to be made aware of the existence of some methods and solutions. He believed himself, his team members and his major stakeholders to have only very basic levels of PM knowledge. He had searched for branded methodologies to use:

"In this case, in the public sector and public administration," and continued *… "We lack more sophisticated tools and procedures which could somehow discipline and organize us."* … before concluding *… "I am still convinced that we lack a systematic approach in the public sector."*

An interesting reflection is that there were, indeed, numerous complaints about the quality of application of PMM techniques, largely relating to the public and education sector. Similarly, R1 provided various examples of PM problems relating to the education sector, often indicating a lack of common tools and techniques. When asked about methodology, he said:

"No, there is no standard project management methodology."

Observation OB2 instead focused on evolution. At the outset a standard PMM could be implemented but as time went on and tacit knowledge was gained:

"Methodologies should be open to improvements, especially those ones initiated by a project team."

Expert K1 indirectly supported the use of PMMs in more chaotic situations. He indicated that after crossing some "tipping point", the intensity of change becomes uncontrollable. In his view, this "tipping point" was characterized by unfavourable contextual situations but also by lack of use of PMM tools. S3, R1, K1 and even A4 directly or indirectly referred to the role of PMMs. Although the researcher was not personally in favour of this concept, he had to respect the data gathered and remain unbiased. This idea was therefore adopted for the purposes of the framework. Yes, there are contextual cases where a PMM could be considered as a starting point from which to bring more knowledge and order into PM-related processes.

6.4.8 Improving accuracy of estimates framework

Table 34 systematizes findings in a more convenient, readable form. Rows present individual methods identified in Section 6.4, ones which support an increase in accuracy of estimates and overall estimation process. The sequence of rows neither describes their relative level of importance nor steps in implementation. Columns correspond to contextual aspects provided in Table 27, and describe a contextually dimensioned project environment which is an output of the conceptualizing process.

Dependencies between methods and context dimensions were marked to help in the process of applying the framework. Four types of dependency are proposed:

1. "Empty" – no dependency identified or no data gathered. An exception to this lack of dependency is when a "+" sign is placed in the column: "Generally considered to be applied". It was marked in this way only if a particular method addressed more than half of the contextual aspects or if experts in general promoted raised practice.
2. "+" – method may be applied.
3. "++" – method is recommended. This designates a high level of significance, the consistent view of experts, or significant examples and observations having been identified.
4. "-" – method should generally be avoided or may carry negative risks. The researcher intends to use this dependency only if absolutely sure.

To provide practical support to the framework's users and to present a scheme of implementation, Table 34 was expanded afterwards with the content provided in Table 35 and in Figure 32 – know-how to apply. The latter element must always start with the delivery of an effective presentation to help shift an audience's thinking from a PMM-based paradigm to one being driven by the individual project and its specific business context.

Two rows of the framework are shaded – rows 11 and 12 – to indicate techniques and methods which should be applied from the outset in order to assure further uptake and update of the framework. Both of these elements also have sections dedicated to them in the know-how to apply guidance – Table 35.

ID	Tools, techniques and methods	Contextually dimensioned project env.														
		Generally considered to be applied	Industrial sector	IT and service sector	Public and education sector	Internal projects (internal sponsor)	External projects (external sponsor)	Traditional PM approach	Dynamic/agile PM approach	International projects	Small organizations and projects	Large organizations and projects	Single-project work environment	Multi-project-assignments work	Mature PM teams and organizations	Immature PM teams and organizations
1	Manage priorities in micro-scale, page 193	+	+	+	+	+	++	+	++		+	+		++		
2	Manage priorities in macro-scale, page 193	+	++	++	++	+	++	++		++		++	+	+		
3	Prepare for and decrease reasons to use multitasking, page 196	+	+	++		+	+	+	+	+	+	++		++		
4	Quiet hours, page 197			+		+	-		+	-	+	-	-		+	-
5	Focus on macro estimates not on a whole detailed schedule, page 198	+	+	+	+	+	++	+	++	+	+	++	+	+		
6	Standardize chunks of work and apply parametric-based tools, page 201	+	++	+								+	+	++		
7	Align sequence of estimation process to business constraints, page 204		+	+				+	+							
8	Visualize and keep competences transparent, page 206	+	+	+		+	+	+	+	+	+	+	+	++		
9	Balance competences, experience and age of team members, page 207	+														
10	Place experts in each major area to provide point of reference, page 209		+	+	+	+	+					++				
11	Customer/stakeholder should see combined plan of all involved parties and accept methodology, page 210	+	+		+					+		++		++		
12	Develop lessons learned knowledge hubs and assure access to them, page 212	+														
13	Reduce and minimize complexity and number of communication channels, page 216											+		+	+	
14	IT tools should adjust to project and work environment context, page 217	+														
15	Apply brand-named methodologies, page 218				+										-	+

Table 34 Framework which supports increase in accuracy of estimates

"No biased estimates" indicator to apply framework

The framework serves improvement of accuracy of estimates. Perhaps surprisingly, a zero value in bias between planned and executed activities could indicate many problems. A project could have been overestimated and buffers consumed. It could be an effect of redundant use of resources. Updates to the contractual baseline could also result in a lack of observed bias. For these reasons, a bias level that is apparently zero is also an indicator to start an investigation into the accuracy of estimates.

Know-how to apply

The sequence of steps provided in Table 35 constitutes a first proposal for the know-how to apply the framework. Although this sequence was not tested due to the inductive, non-experimental character of this work, use was made of those present for framework verification (Section 4.7.8, "Stream – 2") so that know-how procedure was frequently discussed with practitioners to verify its credibility. On the basis of this form of peer debriefing with a PM community, the following steps were formulated:

ID	Step	Explanation, commentary
Introductory presentation:		
1	Deliver presentation on the idea that it is possible to work at the level of tools and techniques and project context. Explain that project context focused thinking belongs to modern trends (Morris 2013). Cover four points: 1. Explain benefits derived from improving accuracy of estimates (e.g. work planning, budgeting, contractual aspects, motivation, lower number of conflicts, milestones protection). 2. Promote "natural" thinking of context triggering or blocking use of techniques. 3. Discuss contextual elements characterizing customer's projects and business specificity. Focus on and underline their individuality. 4. Discuss contextual elements within the framework and try to show similarities; if necessary, extend initial list.	The PM market is under the influence of PMM brands. It is crucial to help the user to understand that PM organizations do not have a monopoly in PM knowledge creation and that the major PMMs often provide general, non-contextualised descriptions. PMMs in general do not search for consensus (Morris 2013).

Assure early acceptance of two major framework techniques:		
2	First – "Customer/stakeholder should see combined plan of all involved parties and accept methodology". Neither plans nor methodological paradigm must be kept hidden, as this may decrease accuracy of estimates and undermine the possibility of applying framework. This is a "call" for transparency.	Stakeholders and all other parties involved in the project should develop a common "vision" driven by an accepted understanding of what the context is and what schedules it affects.
3	Second – "Develop lessons learned knowledge hubs and assure access to them" to support framework adaptation and uptake process. It must become an element of organizational culture that is used in practice.	Knowledge hubs serve as providers of knowledge but also as collectors of reflections. Without this key element, the framework may not evolve and may remain a static, rather than dynamic, concept.
Detailed and focused analysis:		
4	While addressing history of previous projects and on the basis of observed business constraints, start to systematically define list of contextual elements which are typical to your business.	The very first time may be challenging. However, in the future a previously prepared "context register" may be considered as a starting point.
5	Identify contextual elements only from the perspective of your current, particular project and reflect on similarities and differences to the history of previous projects (business context and "context register").	Some contextual elements may frequently appear to be present, some are very characteristic of project, project deliverable, or single activity.
6	From the perspective of your project, divide contextual elements into three groups: 1. Applicable to your project at all times – "persistent" ones. 2. Sometimes applicable, sometimes not – "flickering" ones. 3. Undecided, unclear – "blurred" ones.	Contextually, it may help to manage priorities. Thus, the "blurred" group should be kept as small as possible.
7	While being aware of the project's goal and success criteria, can you influence its context?	This topic remains unaddressed by this framework from a know-how perspective. However, among others, Morris (2013) points to this as a future trend – the practice of shaping project context.
8	While comparing, you may initially extend the list of the framework's contextual dimensions	As a first step, consider adapting the framework to better fit it to the specific

	while focusing on identifying "persistent" and "flickering" ones.	business and project context.
9	Identify the set of PM best practices, tools and techniques that are available, both methodologically and technically. Search for similarities to the framework (rows).	Focus on the ones you are the most knowledgeable about.
10	While comparing, you may initially extend the list of the framework's tools and techniques. Remain very careful and bear the goal of improvement of accuracy of estimates in mind.	This may be considered as a second step in customizing the framework to better fit it to an individual organization.
11	Revisit with users and major stakeholders the goals of the framework's application: improved accuracy of estimates, a more realistic estimation process and increased stability of managed projects.	To remind about and recap the goal of the process.
12	Start to use the framework to guide the setting up of links between contextual elements and tools applied. Assess the "persistent" and "flickering" contextual elements previously defined and agree on the tools and techniques they trigger.	Framework initially advises, on the basis of contextual dimensions, what methods should be applied or avoided.
13	Initiate internal business mentoring programmes to widen understanding of context and tools and techniques.	Aim to embed process as a form of best practice.
14	Use the lessons learned process and focus on reflective thinking to propose updates to: 1. Framework – contextually dimensioned project environment. 2. "Context register" – in reference to observed project and business context. 3. Framework – tools and techniques. 4. Framework – types of dependencies.	There is a risk of applying redundant updates, especially within the domain of the framework's rows relating to tools and techniques, which could – in a worst case scenario – even decrease accuracy of estimates.

Table 35 Framework's know-how to apply

This will not preclude detailed questions being raised by way of potential criticism, but this is why the first step of know-how to apply guidance is dedicated to presentation of the framework's idea. Activities which avoid the risk of initial over-structuring of an implementation project and demonstrate practical openness to the customer's context were confirmed to be preferable. Here, a project's individuality and one showing adaptability from the outset may displace the terms complexity, local irrelevance and impracticality. To better support understanding, the major steps were formulated in Figure 32:

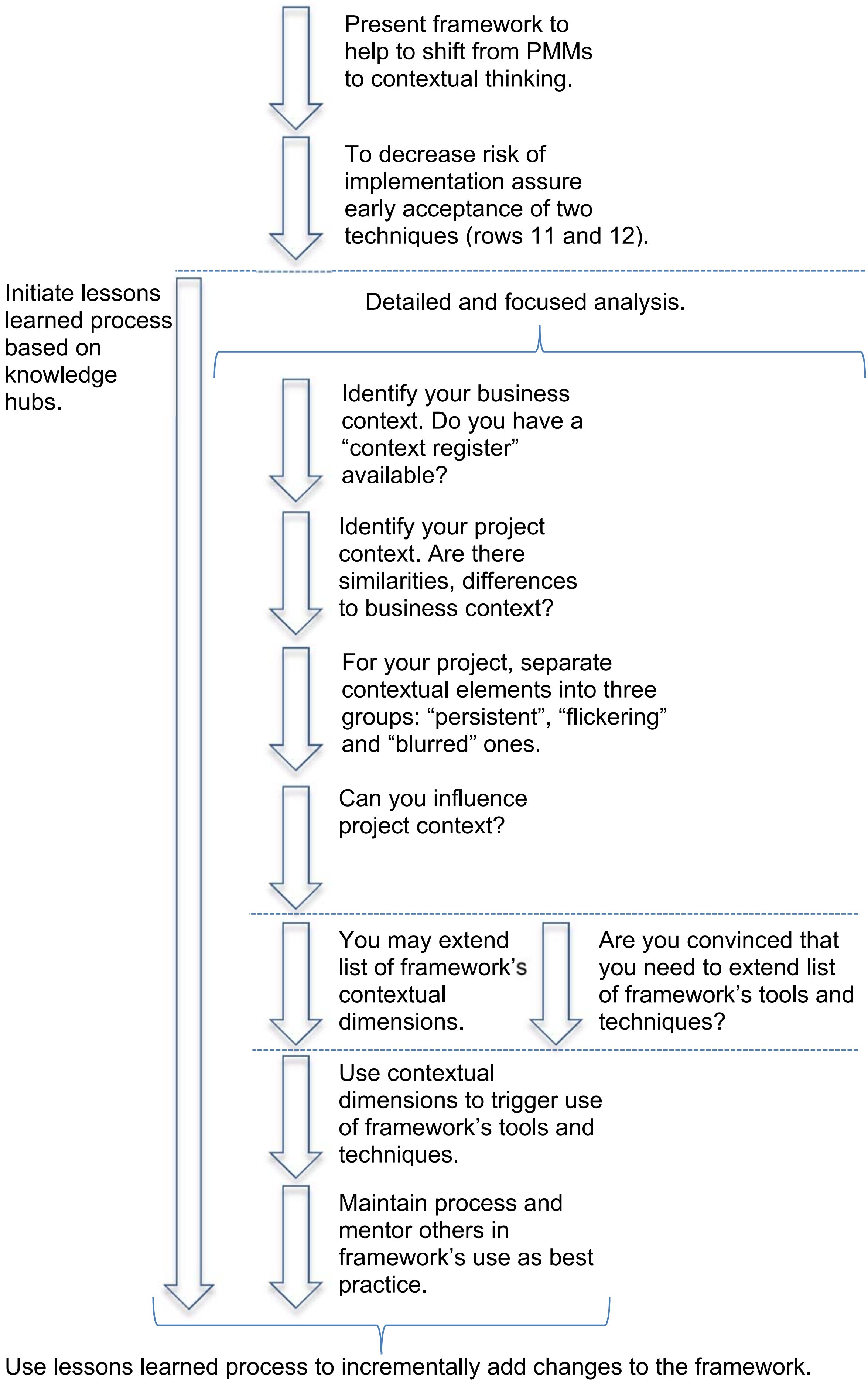

Figure 32 Diagram visualizing know-how to apply

“Stream – 2” contribution to the framework development process

“Stream – 2”, as presented in Figure 12 and documented in Appendices 5 and 6, served as a PM community debriefing panel, to some extent addressing a style of peer review meeting practice. It must be underlined, though, that “Stream – 2” was not planned or executed for the purpose of experimental or project-based testing of the framework. However, due to its long time frame and the number of meetings conducted, it provided contributions to the “Stream – 1” conceptualization process and the overall framework concept formulation, especially with reference to its – know-how to apply. The most important contributions that “Stream – 2” provided to the research project were as follows:

1. Alongside “Stream – 1”, maintenance of almost permanent communication with the PM community, allowing mitigation of the risk of having the framework dismissed as irrelevant to PM practice.
2. Assuring rapid access to required interviewees.
3. Assuring the ability to apply strict measures (section 4.6.2) to the selection of experts and still be able to successfully identify appropriate individuals.
4. Ongoing maintenance and development of the researcher’s skills, and his perception and understanding of the overall PM sector and the planning and estimation process within it. The value of this should not be underestimated: the insights gained through this practice increased the quality of the conceptual network development in “Stream – 1”. As a result, the “Stream – 1” process was not a mechanistic (Drouin et al 2013) “coding” but rather a “journey” in PM practice driven by the practical knowledge of people encountered here. In qualitatively and inductively organized PM research projects, the integration of PM practice with researchers’ experiences is one of the most noticeable trends of recent years (Drouin et al 2013).
5. Observation OB3, as an element of “Stream – 2”, was conceptualized to support the discussion in Chapter 6 that aimed to address the project’s objectives. This decision was taken largely because of the long length of this observation and its ability to address estimation processes in various areas of corporate business ranging, for example, from industrial, organizational/administrative to IT projects.

6. The subject of “Acceptance or reflection” arose some 577 times during the course of meetings within this stream, as illustrated by the summarized significance level scores for this particular group shown in Appendix 6. This clearly served to increase confidence in the results obtained, especially with respect to a tool selection process driven by project context and aimed at improving estimation accuracy.
7. The early identification of the requirement for “Adaptability to the project context”, another subject group that achieved a very high significance level (score 514) in “Stream – 2” meetings (Appendix 6). This requirement also influenced the decision not to aim for too generalized framework that many might interpret as over-generalization, so excluding it from any consideration for use.
8. Enabling the collection, again presented in Appendix 6, of a list of ideas for further development of the framework, which can be used in the future. This is especially visible in the groups of topics, “Development of the framework” and “Development of the framework – software”, covered in “Stream – 2” meetings, having a high overall combined significance level (score 709).
9. Two further subject groups from “Stream – 2” meetings greatly influenced the formulation process for the framework and its application know-how. Thus, the group “Ease of understanding and use”, with a significance level of 303, directly affected selection of the simple framework layout. The second group, “Implementation”, with a very high significance level score of 813, helped to position know-how to apply, as a process that must be easy to understand. The latter was strongly supported by making use of the lessons learned that were indicated within the “Knowledge management” group, for which a significance level of 327 was achieved. However, this was not a substitute for the conceptualization process dedicated to KM in “Stream – 1”. It should be remembered that the “Stream – 1” conceptual network served mainly to provide answers to the research project’s objectives and the formulation of the framework’s layout, while “Stream – 2” helped to socialize and review the framework with the PM community, and formulate its know-how to apply (Figure 32).

10. Importantly, identifying potential risks, as captured in the "Stream – 2" meetings subject group "Risks", again described in Appendix 6. It is interesting to note that, from a RM perspective, framework adaptability could also be perceived as a potential source of chaos. The framework could evolve independently on many contextually-different projects within a single organization. What if resources were to be shared between those contextually different projects? Although it acquired a relatively lower significance level, a group of subjects associated with "Verification in PM practice" clearly sets out an expectation that the framework should be tested. Thus an experimental approach, bringing these two areas together to address multiple and contextually different projects sharing the same resources, and managed under one organizational "umbrella", might provide an interesting field for future testing.

Framework trustworthiness and limitations of application

The researcher trusts in the dimensions proposed as well as in the proposed tools and techniques. However, credibility could be considered as somewhat limited due to the types of dependencies used. The marks "+", "++", "-", and "empty field" were given principles of application. Nevertheless, in many cases the researcher was forced to assure himself of the correctness of the dependency applied. This required time-consuming reanalysis of the transcribed text and recorded materials, sometimes identifying not only what was said but also how it was said, in order to pick up the emotional levels typically involved. This could influence the decision to apply the "++" mark. If an expert raised their voice, spoke more rapidly and gave quintessential examples, then such expression had significance. However, when compared to the identification of methods, it was a much more time-consuming process and attracted higher levels of uncertainty.

The conceptual network indicates that the methods proposed within the framework complement each other. These sorts of dependencies could be visualized by applying groups of techniques which might improve understanding, and simplify the process of application. It seems that, on the basis of the axially coded data, aggregating methods into three or four groups could be feasible.

The number of techniques that were identified was satisfactory. However, the contextual dimensions presented in the columns could be more detailed. Would it increase trustworthiness? Not necessarily, in the opinion of the researcher. Having had experience of the inductive process, certainly any new unique contextual dimensions would require new unique cases and interviewees. Unless they could not be identified in this way, adding new dimensions could decrease trustworthiness.

Both contextual dimensions and methods could, to some extent, be regarded in a similar manner. Perhaps some of the framework rows could be used as contextual dimensions? Contextual dimensions are, by definition, considered to be ones that are not under the control of project team members (PMI 2013, p.29). Is it always that clear what is or is not under such control? There are factors like multi- or single-project work environments which, arguably, are not up to a team to decide. There are also less obvious contextual elements present. This sometimes unclear dichotomy of understanding around what is a method and what is a contextual dimension will very likely persist.

Another limitation could be related to implementation risk. The framework is about changing practices. Change management implies conflict. Potentially, implementation of this list of best practices should be contractually regulated and considered as an external, consultancy-based project. This would at least assure an opportunity to establish a formal basis for an implementation project.

Furthermore, the framework "responds" to context and uses it to shape choices of tools and techniques. Morris (2013) described this as an element characterizing future PM. However, he goes further, suggesting that solutions offered should be able not only to "respond" to project context but also shape it.

Finally, this framework will result in improvement only if it fulfils from the very beginning two of the proposed techniques and methods: "Customer/stakeholder should see combined plan of all involved parties and accept methodology" and "Develop lessons learned knowledge hubs and assure access to them". From a methodological perspective, the parties involved (i.e. customer/stakeholder, sponsor, project manager and project team) should use a "contextual focus" and systematically organized lessons learned to openly drive the process of adaptation. It cannot only be good intentions, rather it must become an element of organizational culture that is used on a practical basis.

Possibilities to evolve and develop

If a source of data was to be identified which corresponded to a new contextual dimension, it would be possible to further develop the framework. The list of tools could also be increased in a similar manner. Nevertheless, since usability and applicability should be maintained, an uncontrolled increase in complexity should be avoided. However, the framework should be subject to further updates which will improve the model and make it more comprehensive.

For example, one alteration to the framework could be based on its use in more experimental, long-running approaches, where each application of the tools to observed projects and organizations could be considered as an iteration which may result in further updates. That said, and while bearing in mind limitations, PM practitioners could at some stage of the framework's saturation process, become more proactive and start to shape a project context, instead of simply reacting within it.

6.5 Third objective – increase in knowledge level in relation to increase in accuracy of estimates

6.5.1 Introduction

The third objective was dedicated solely to KM. It required a focus on the relationship between knowledge and increasing the accuracy of estimates. In particular, it was intended to investigate whether continuing increases in experience and tacit knowledge are helpful to increases in the accuracy of estimates. It can seem that this is what business practice routinely expects.

To accomplish this objective, the researcher again analysed the conceptual network to identify those elements which addressed the problem. The brief elaboration provided in the next section does not repeat the analysis process from Chapter 5, Sections 6.3 and 6.4. Instead, it summarizes the identified reflections in order to respond to the research question posed.

6.5.2 Is increasing knowledge always favourable to accuracy of estimates?

It was possible, inductively, to identify different types of knowledge. The major distinction was found between an experienced expert and an experienced practitioner. An expert's increase in knowledge could typically be recognized as improving the planning process and thus increasing the accuracy of estimates. Knowledge development in experts could be described as gaining the ability to consider a larger number of potential contextual aspects. In the case of practitioners, the result was more ambiguous, and overly experienced ones could, indeed, start to overestimate. Through competition for constrained resources or time they could even destabilize the whole planning process. Compared to experts, they did not necessarily consider such large numbers of contextual aspects. Practitioners instead became more sensitive to particular ones. Their work was not focused on benchmarking projects' contexts and drawing conclusions together into associated reflections.

When P1 considered practitioners, he often addressed their dedication to the technical aspects of deliverables. This approach could undermine the business goals of the project and thus result in the re-estimation of plans. P1 simply viewed overly experienced practitioners as a source of risk in ignoring workload unrelated to technical issues.

This problem was also addressed during the interview with M1. He considered practitioners and was thinking of a team member's "history". He explained:

> *"So, of course, people are not getting to that point very often and they need some contingency in their estimation."*

As already discussed in Section 6.4.4, during formulation of the framework it seemed that there is a middle ground in the value of gaining experience. This idea is coherent with reflections collected through OB2 and OB3. This middle ground serves as the most favourable to accuracy of estimates. Above it, a practitioner may start to overestimate or destabilize the planning process; below it, he or she may tend to underestimate.

Potentially, the practitioner could be "converted" into an expert by widening his or her spectrum of perceived contextual factors. This might be achieved through controlled job rotation or a more permanent change of the working environment. It seems that the capacity to compare different projects and contexts is a must. Also, since under-experienced and being overly optimistic were observed as well as overly experienced, it may be appropriate – as indicated in the framework – to balance experience within a project's team. Many factors could be considered here – even the ages of team members.

6.5.3 Conclusion

Increases in experience led to different results in the cases of practitioners and experts. Risk is mainly associated with practitioners, primarily due to their different type of involvement in projects and a focus increasingly placed on particular contextual project aspects. It was not always the case that increases in experience led to increases in the accuracy of estimates. In the case of practitioners it starts with probable underestimation, moves through correct estimation and eventually results in probable overestimation.

It suggests a middle ground of experience as being most favourable to the estimation process, and this could be maintained by the suitable composition of project teams. It could also be supported by gradual “conversion” of practitioners into experts, by allowing them to experience more, differently configured contextual environments. The researcher did not attempt to answer whether this could be achieved through a dedicated learning process or rather through controlled job rotation across a variety of projects. The overall conclusion is that increases in a team’s tacit knowledge must be monitored closely.

6.6 Fourth objective – BM concept as a subject for improvement

6.6.1 Introduction

The CCM concept was built on two “pillars”. One was to schedule project to resource constraint. The other was to secure deadline by proper BM (PMI 2013, p.178). In Section 2.4.4, reasons for overestimation were described, and followers of CCM concentrated on the issue of inflated buffers. Could this approach effectively be re-discussed with attention paid to PM community?

An analysis of the literature revealed both criticism and acceptance of CCM and BM concepts but the pilot study and inductive character of this thesis introduced additional insights to the situation. Some experience was also gathered before this research project was formally started.

6.6.2 Problems and improvements

Acceptance of “as is” state

Goldratt (1997) seemed to accept the “as is” state and did not search for a context-driven way out of the problem of fluctuating schedules. He simply accepted that inflated estimates would be present. The researcher partially shared this view but at the same time struggled to decrease volatility of estimates. There could be the risk that behind unconditional acceptance of the inflated BM concept there is some wider tolerance of this assumption and thus to a quality of planning which accepts inaccuracy and may increase schedule volatility.

Having said that, observation OB3 also proved that a tolerance of such project volatility caused project managers to similarly tolerate dismissal of estimates previously created. It became part of a culture of ever-changing priorities. What would happen if, instead of pessimistic experiences, someone started to talk – as K1 did – of discipline and, as the framework suggested, of macro- and micro-priorities management? Goldratt (1997) recognized the role of milestones but it seems that alongside the discussion of buffers, a discussion of priorities management could be given similar consideration.

Thus BM potentially should, if applied, be used in conjunction with techniques aimed at increasing the accuracy of estimates. Of course, it could be asked whether one should, indeed, focus on improving the accuracy of estimates or acknowledge that it may not be a suitable situation in which to undertake this challenge. This aspect is discussed in Section 6.7.

Pilot study contribution to critical chain buffer management

The sample used in the pilot study was limited. However, this was not a drawback since the aim was to verify if, while analysing buffers, it is possible to only consider overestimation. The CCM concept advises what to do with safety margins and how to use them to better secure project deadlines. It suggests that milestones could be assigned earlier dates by decreasing the size of the summarized buffer and thus providing savings, including earlier release of project resources. Taking into discussion the findings derived from the pilot study, some potential improvements to the CCM and its BM could be inferred.

Figure 33 depicts this shift in the perception of BM. Alongside the overestimation – positive buffers, underestimation – negative ones could be identified. Thus, the entire value of the summarized buffer would be smaller than suggested by CCM and presented in Figure 8 and Figure 9. It is practically useful to understand what would happen to the project deadline if negative buffers were to be recognized.

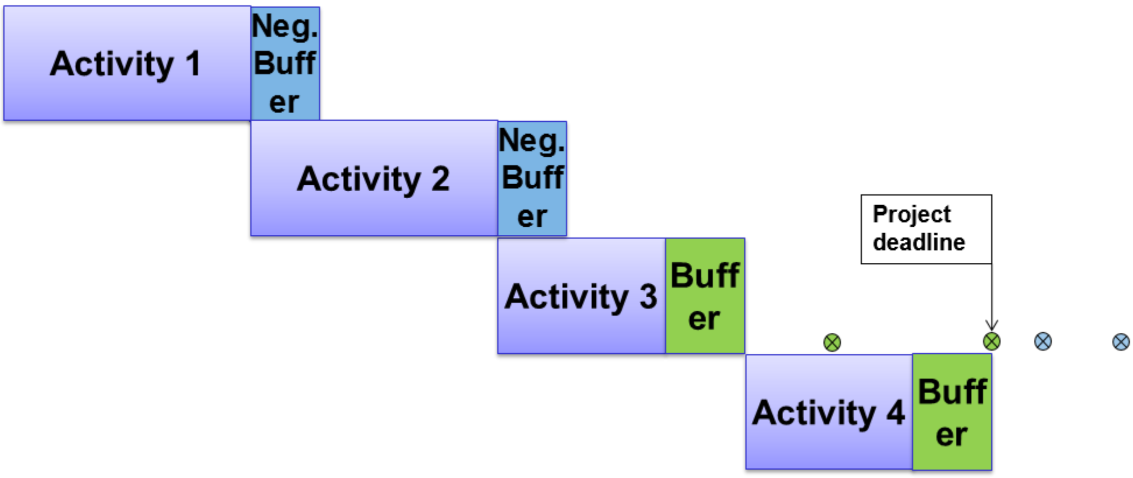

Figure 33 Project with inflated buffers as well as underestimated ones – negative buffers

Figure 34 shows the situation one step further on. For example, investigation into the accuracy of estimates provided evidence for the existence of underestimation in Activities 1 and 2. In this situation, the summarized project buffer barely secures the project deadline. The buffer is smaller and potentially should not be additionally decreased, as achieving the project's promised deadline would be placed in greater jeopardy.

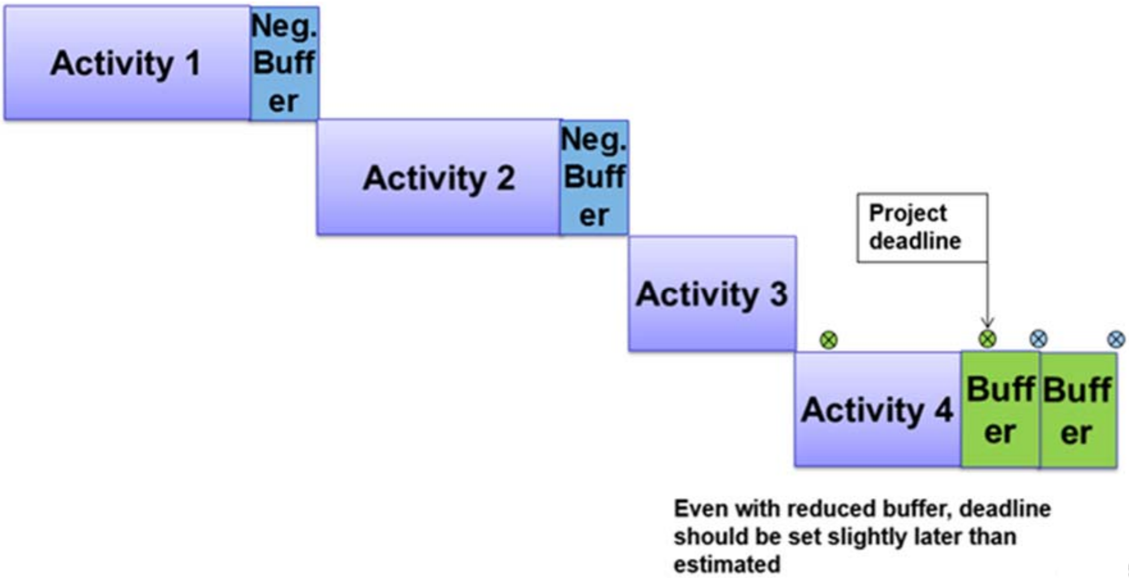

Figure 34 Project's summarized buffer revealing need to postpone project's deadline to better secure delivery date

Ironically, even if the buffer were to be decreased, a model which respects the existence of underestimation could still demand that the project deadline be set even later than planned to preserve what is left of safety margins. In this respect, the pilot study contributes the introduction of an idea which is, put simply, absent in CCM. Savings achieved by buffer reduction are very tempting but savings can also be secured by not straying into contractual penalties. Thus, BM that proposes more reliable deadlines may be considered to be an indicator of best practice, especially if backed by a more accurate estimation process which acknowledges underestimations as well.

In summary, treating buffers as though only being inflated would be incorrect. Extra decreases in buffers must be considered carefully. While also having underestimated schedule activities it could be that instead of promising savings and decreasing buffers it may become necessary to postpone the project's delivery date. This contradicts the view of CCM and its BM. In the pilot study, percentage of underestimated activities varied, depending on the interviewee from 5% to 60%, with an average of 26%. Similarly, S1 also acknowledged the existence of underestimation and pointed to 80% of activities having been overestimated. In general, the number of underestimated activities was considered to be smaller than overestimated ones.

Surprisingly, those who had had more formal and extensive education in PM preferred to support the view promoted by Goldratt (1997). However, regardless of the level of PM knowledge, the application of this BM concept was rarely practised. OB2 and three experts – P1, M1 and K1 – suggest that being overly pessimistic resulted in overestimation. On the other hand, when asked if they could give examples of frequent use of CCM and its BM methods, they were unable to do so.

Intellectual setup time and two "faces" of multitasking

Setup positioned as a preparation for work was an analogy to the setup found in repetitive processes. In CCM, multitasking was perceived negatively, as something that could decrease efficiency and demand additional buffers. Indeed, the uncontrolled multitasking described by K1 or the hidden schedules within complex multi-organizational projects indicated by K3 may well lead to decreases in efficiency. K1 considered intellectual setup as part of a "machine" for chunking activities and said that project managers should decrease expectations of multitasking.

However, K1 indicated that in a multi-project work environment being able to multitask may lead to increases in efficiency, which could help estimates remain more accurate. If the buffer concept is, indeed, about the management of inevitable change then preparation for it by management of competence profiles may be a welcome practice. K1 called this a "statistical effect", simply assuming that being able to multitask and having short intellectual setup times would allow the use of spare timeframes in a multiple-schedule work environment.

Undervalued role of knowledge management

The role of knowledge or, in particular, the style of KM became increasingly vital during the research project. Should project mistakes primarily become a source of pessimistic experience? Different attitudes are possible. S1 considered project mistakes as opportunities to learn. He tried to understand and analyse what they did and did not do correctly. If suitably applied, lessons learned process could decrease the impact of pessimistic experiences. Here again, as discussed in Section 6.5.2, a difference between practitioners and experts should be recognized.

It seems that estimates should be verified for the purpose of future lessons learned and KM. If this is not done, then scheduling to resource constraint could not be trusted since it might be wrongly identified. Such a false "bottleneck" would also result in the incorrect placement of buffers. An increase in the accuracy of estimates or at least some level of verification, with indicated points of reference to recognize bias, should help CCM to function better.

6.6.3 Conclusion

It seems that the present approach in CCM towards BM can be broadened. It might incorporate into its calculations not only positive but also negative buffers. Regardless of used technique, potential underestimations must be respected. This finding could, potentially, propagate dynamic approaches even more in support of PM by making buffers more configurable and responsive to project context and thus be better received by the wider PM community. One might also seek to make them more oriented to project milestones, in order to be able to propose milestones whose achievement is more feasible – both earlier and later.

Above all, CCM addresses project constraints. However, it may be that in CCM the definition of constraint was oversimplified to a resource-defined “bottleneck” (PMI 2013, p.178). It was initially considered by P1 when he called for:

“Aligning sequence of estimation process to your business constraints.”

It seems that a constraint could take many forms. What if, to start with, a typically unstable process be considered as a major constraint instead of immediately engaging in CCM resource queuing and buffer identification? What if, after such an unstable process has been improved, other resources than those previously assumed emerge as major constraints? The possibility of causing such mistakes suggests that simplification of management by constraints may lead to incorrectly set critical chains.

Finally, multitasking should not be perceived entirely negatively: it may be possible to make use of a schedule’s available timeframes through well-managed competences and reasonably short intellectual setups. Furthermore, project mistakes present opportunities to learn and CCM should accept them as such, rather than treating them simply as sources of pessimism-inducing experience.

6.7 Fifth objective – increase in accuracy of estimates or applied flexible planning principles

6.7.1 Introduction

Is it reasonable to aim for the most accurate estimates possible? Are traditional methodologies “better” or “worse” than agile or buffer-based approaches? Following that pattern of thinking could lead to the descriptions available in the literature relating to methodologies that are dynamic/agile to a greater or lesser degree. This research project resulted in a major idea which was somewhat surprising: dichotomy in the choice of methodological approaches is misleading and thus it is not necessary to answer the questions raised. It is more efficient to seek compromise at the level of tools and techniques, choosing them for each individual contextual situation. This idea started to suggest itself at the very beginning of the expert-driven research process and was confirmed more definitively through formulation of the framework in Section 6.4.

6.7.2 Is it necessary to choose?

Expert P1 was of the opinion that, in general, the entire project structure should serve a business goal:

> *“To cure this all you have to change the method of concentration, defining parameters of project success. We should concentrate on business goals not on a product goal.”*

He thought here of the PMMs and estimation process used, as well as definitions of project success. Generally, according to the experts, this problem was somewhat related to what came out of lessons learned. If the methodology is subject to a continuous improvement process then the problem posed regarding a binary choice ceases to exist. The reason is simple. Each individual improvement by its very nature does not improve some abstract methodology but affects specific tools and techniques. It may even remove a tool or promote a new one regardless of the business knowledge area from which it had originated. If the correct lessons learned process was introduced, then the evolutionary process would begin. Experts even anticipated that a team member should be able to develop his or her own processes.

To give an example, if long-term planning brought disappointment when comparing planned and executed estimates then new techniques could be introduced, e.g. long-term milestone scheduling, short-term rolling-wave planning or even BM. From the perspective of one output of this research, the improving accuracy of estimates framework could also be tested. Similarly, if project meetings are taking too long then why not try stand-up meetings? It is driven by lessons learned and the evolution of reflective learning to assure constant movement in the direction of better synchronization to business context and thus to the project's business goal.

Agile approaches often find application in the IT sector. S1 was an IT practitioner and thus, logically, might typically opt for agile solutions. However, he instead said something which sounded like "it depends":

> *"Again it depends on the type of project, the nature of the project. Sometimes we make a plan for three or four years. Sometimes we make a plan when we have made some progress: then we start another planning round."*

This indicated that, regardless of beliefs, context may vary from project to project even in the same sector, and may result in changes to PM estimating practices. It was another argument for lessons learned driven evolution to be run at the level of tools and techniques. It was also coherent with one of the requirements contained within the proposed framework, i.e. that which indicates that customers must accept the methodology. Yet, customers are not all the same: they represent different organizational cultures, as well as having different personal characteristics. Especially in the context of external projects, corresponding relationships could change significantly from one project to another.

This being so, were there situations where a "no go" light existed when it came to improving accuracy of estimates? The conceptual network and contextual dimensions led to two conclusions – two areas of uncertainty regarding whether stability could or should be primarily increased:

1. Immature PM teams and organizations required support in terms of the most basic PM knowledge. It was even more evident when comparing the views of experts and practitioners. Practitioners quite often simply called

for basic knowledge. In such a situation the implementation of the framework's improvements could become complicated, even if considered from a perspective of familiarity with the vocabulary, abbreviations, definitions and sometimes simple algorithms hidden behind the tools. Therefore, a business knowledge base should be built in the first instance.

2. Another field which offered conclusions, and sometimes controversy, was related to the public and education sector. There was less freedom here than in the industrial, IT and service sectors, thanks to legal requirements and a frequent lack of joint motivation to improve the situation, which was surprising to the researcher who had not had experience of the public sector. Although this finding was considered to be mildly controversial, the "C. – PM., Subcat. – Public and education sector" subcategory, nevertheless, became well-conceptualized and achieved a high significance level.

6.7.3 Conclusion

In summary, the general conclusion is that one should improve accuracy of estimates as long as lessons learned does not provide any other set of methods. In other words, in each individual contextual case the answer to the question posed by this objective will not be found if the lessons learned process is dysfunctional. It should be assumed that lessons learned can modify the configuration of tools to the specific context. In the light of this, any debate of whether a more traditional, CCM-based, dynamic/agile or even hybrid approach is a better fit seems to represent an unnecessary choice from only a few named of the whole spectrum of possible structured responses to a project's context.

Nonetheless, the fulfilment of a functioning lessons learned prerequisite may not be sufficient. Adaptability may also be constrained if basic PM knowledge is not present. In addition to this, there are some unique cases where the number of regulations and constraints impair the possibility of improving the accuracy of estimates and even the discussion or selection of a particular approach. Several examples of such contextual configurations, characterized by narrowed "freedom of movement", could be found in the public sector.

6.8 Findings from a literature perspective – brief review

6.8.1 Introduction

The output of this research project might be considered controversial since it did not follow any commonly known PMM. Notwithstanding this, a study of the literature suggests that any such controversy is unjustified. The deliverables generated can be located within the new trends visible in PM. As an example, Morris (2013) indicates that in the future, learning and development will be linked "more plurally" (p.17), resulting in a variety of adaptable PM forms. Achieving adaptability through lessons learned appeared to be a conditioning element of an induced framework. Morris (2013) suggests that PM will be characterized by "self-organizing and knowledge communities" (p.17) making use of configuration management, more fluid organizational forms, better influenced context and operational scenario planning. It is gratifying that, quite independently, the findings inferred through this research follow a similar track.

In comparison to "characteristics of a good estimate" (PMI 2011, p.14) this dissertation has broadened the view of PMMs. It seems that the inductive approach helps to shape a paradigm for structuring an "answer" to the inaccurate estimates that are observed. The following elaboration briefly touches on additional reflections with regards to the literature.

6.8.2 Ambiguous role of knowledge and experience

Findings related to knowledge and experience were to some extent consistent with the view provided by Gemino et al (2015) and Wells (2012). Indeed, as experience increases, tacit knowledge may become superior to PMMs. However, the present findings somewhat refine this view, indicating that increases in experience must not be treated as continuously favourable to the accuracy of estimates and thus to the quality of the planning process. This lends credit to the teachings of earlier research (Leonard-Barton 1992; Levinthal and March 1993; Schultze and Stabell 2004) where not just the "value of knowing" is considered. The phenomenon of being overly experienced exists and may lead to overestimation. That is why team experience should be balanced, transparency of competences assured, and practitioners and experts properly identified.

Wells (2012, p.57) offers consistency with another verified conclusion: where tacit knowledge exists at low levels, PMMs should come into play. It seems that increases in knowledge and experience render the use of PMMs less important. Nonetheless, in order not to adversely affect the accuracy of estimates, such “increases” should be carefully monitored and managed.

6.8.3 Change management and use of lessons learned

Change management, in conjunction with lessons learned, is recognized as supporting adaptability. It became one of the vital elements of the framework and is consistent with the view delivered by Knowles et al (1998, p.12) in which the learning process is conditioned by the existence of change. It also follows the “global standard” (PMI 2008a, p.102) which underlines the necessity to conduct this process and finds its application in the “process improvement plan” (PMI 2013, p.78).

If reaction to change is indeed emotional (DeMarco and Lister 1999, p.197), then – from the perspective of the findings – this may be used to support lessons learned in improving the accuracy of estimates. However, it should be noted that the findings also indicated that there was some level of change intensity above which a situation becomes uncontrollable. This effect seemed to be amplified by poor PM as, for example, managers often do not frequently resource-level their projects (Leach 2000, p.118). Moreover, in a multi-project situation, amplification of problems may become significant. There, coordination may fail since “work executed by teams often depends on the work and input of other teams” (Artto et al 2013, p.6). Support for this view came mainly from the research’s experts.

Finally, the research project discussed the use of KPIs in lessons learned. Amongst other aspects of scope, budget and time can be measured by corresponding KPIs. It was shown that KPIs may distort the focus on a project’s business goals and result in corrective actions being subsequently required. Two experts supported the view that KPIs should not necessarily be part of a lessons learned process. Recent literature seems to address this topic: “How often do project managers work to realize business outcomes rather than just delivering to scope, in budget and on time?” (Morris 2013, p.16).

6.8.4 Communication efficiency and estimating methods

One proposition present within the framework was that the customer/stakeholder should see the combined plan of all involved parties and accept the methodology adopted. A requirement for this was especially visible in large organizations and multi-project work. This problem was also recognized by Artto et al (2013) where reaction differs between centralized, decentralized and balanced coordination schemes. Even though Artto et al (2013) claim that highly interactive teamwork should not rely on schedules and plans, they eventually admit that "if the task specifications are vague, coordination that relies mostly on inter-team contacts may result in several planning cycles, enormous problems in integrating deliveries of teams, and budget overruns" (p.15). This view on the problem is consistent with K3. It is also confirmed in older papers where in situations of uncertainty, unclear task specification and multi-team work, centralized coordination may decrease stakeholders' confusion (Daft and Lengel 1986).

On the topic of communication, Beringer et al (2012) offer similarities while considering efficient communication with stakeholders and priorities management. Here, and unlike Burke (2003), emphasis was not placed on conflicts between project and functional management but was rather broader, related to communication channels failing for many reasons. Discussion was focused on the associated processes and not on organizational structures.

Surprisingly, while considering improvement in the accuracy of estimates, interviewees did not address complex mathematical models or group decision-making techniques. For example, brainstorming and nominal group techniques (PMI 2013, p.171) were not covered even by the experts. Even during the two years of observation OB3, the researcher did not encounter regular use being made of these methods. Techniques supportive to the estimation process were mainly confirmed as parametric or expert-based (PMI 2013, p.171). Moreover, within the discussion of IT support to accuracy of estimates, generally described tools like high-quality online access to websites (PMI 2013, p.292) or information systems (Burke 2003) were not emphasized. Focus was instead placed on flexibility and specific functionalities, e.g. their fit to the specific project context and their support of the deliverables expected.

6.8.5 Perception of BM and TOC

The view of Trietsch (2005b) and other critics of CCM and its BM was confirmed and, indeed, the approach to BM proposed by Goldratt (1997) indicated as untenable. A charge of oversimplification should be directed at buffer calculations and their connotations with protection of milestones. Giving consideration only to positive buffers is invalid and the existence of underestimations calls for an update of present methods of calculation.

The TOC, present in CCM, also acquired a slightly different meaning. It was not regarded as a tool for scheduling to the most constrained resource. Instead, it was more broadly understood as a sequence of planning to be followed in subordination to a "bottleneck", regardless of what this was. For example, why not focus to start with on the throughput of the planning process workflow as a major existing constraint?

6.8.6 View on traditional and dynamic approaches

Morris (2013) indicates that in an agile approach, delivering "takes priority, even if it means that more resources are needed" (p.11). In this research, it was concluded that if "The iron triangle is abandoned!" (Morris 2013, p.11), this is not conditioned by the use of an agile approach, but by careful observation of project context and project constraints. The findings related to the choice between traditional and dynamic/agile approaches are consistent with the view of authors investigating a contextual perspective (Chin 2004; Conforto et al 2014; Kruchten 2013), although this research project also considered the possibility of improving estimation accuracy and did not regard agile as mainly usable only for software development. It seems that from a lessons learned perspective, agile and traditional PM approaches may be considered together as long as it is from the perspective of tools and techniques used by a "reflective practitioner" (Clarke 2010, p.5).

As a result, the answer to the question of whether projects are best managed "by drafting a completely custom process for each and every project?" (Fewell 2010, p.27) is as follows: a process that is not completely customized should be efficiently derived for each project through the support of a configurable framework or other configurable solution (if identified).

6.8.7 Public sector and limitations to improvement of accuracy of estimates

From the perspective of the literature (Flyvbjerg et al 2002a, 2002b), the public sector is an example of a domain in which sponsors knowingly set their budgets low, i.e. deliberately underestimated. The data confirms this tendency to underestimation and also suggests that improvement in the accuracy of estimates or having a choice of various approaches may not always be feasible in this sector, mainly as a result of specificity in contextual configuration, and the existence of many constraints imposing a reduced "freedom of movement".

In addition, improvement in the accuracy of estimates may also be constrained if basic PM knowledge is not present. Here PMMs could provide team members and stakeholders with a basis for entry-level PM education until the use of tacit knowledge becomes possible. Even if working with more developed teams, Cleden (2009, p.23) assumed that some residual uncertainty remains, regardless of the quality of the planning process. This view was sustained and focused on personal behaviours, which is consistent with the approach of Frosdick (1997, p.169) who considered personal characteristics as an explicit risk factor.

6.8.8 Conclusion

On the whole, this thesis "followed" – to a certain extent – recent "critical schools" (Crawford et al 2014; Hodgson and Cicmil 2011; Hornstein 2015; Kerzner 2014; Oellgaard 2013; Svejvig and Andersen 2014) in which project context may be seen as more important than PMM, and where context may offer not one but many "silver bullets" (Špundak 2014) to problems encountered, and can configure the answer through selected methods and the use of a continuous learning process (Hartmann and Dorée 2015; Leybourne and Sainter 2012).

The framework created does not attempt to directly shape project context as some would expect (Morris and Geraldi 2011; Morris 2013). But should an adaptable framework, driven by learning, not be considered as an example of such a policy? It may depend on the recipient of such a learning process. What distinguishes this research from that of "critical schools" is that its anchor point and focus is based on the accuracy of estimation, which is used to drive improvement and offer greater practical orientation. The approach proposed should be considered as an example of making actual use of contextual awareness.

In addition, while focusing on the principal objectives, this work also allowed the opportunity to consider gaps in, or scarcity of, scientific discussions with reference to the accuracy of estimates. The research did not constrain investigation to one particular business sector but remained contextually open and aware. The research design adopted exploration and did not focus on one exemplary case limiting broader debate. From the perspective of the framework's methods, exploratory openness was maintained.

Furthermore, and especially with regards to BM, the researcher has maintained a constant verification of socially agreed understanding with PM practitioners and the PM community over a number of years, in contrast to the great majority of papers analysed. Among other things to consider – the impact of PM "gurus" and the social movements that follow. In short, this research helps to fill a knowledge gap in relation to the combination of BM, the driving role of project context, both overestimation and underestimation, and – finally – a perspective of improving and managing the accuracy of estimates.

The research focus was turned to the micro-activities level to confirm the dual existence of positive and negative bias even though many papers prefer a macro-level perspective when discussing overestimated or underestimated projects. With reference to the accuracy of estimates, the "value of not knowing" was identified, which is unique by comparison to the great number of papers focused on the "value of knowing". Finally, papers discussing mixed/hybridized solutions beside traditional and dynamic approaches (Binder et al 2014; Jahr 2014; Špundak 2014) were indirectly challenged, primarily through the logical recognition of hybrid, traditional and dynamic/agile standpoints as examples of contextually focused "answers", ones that are just a few of those that could be selected from a presumably infinite file. In short, the researcher, even if it was with a specific focus and individual objectives, unintentionally became a member of the "critical schools".

6.9 Findings in research design

6.9.1 Limitations of CAQDAS

Desired improvements

Each CAQDAS system represents a set of functionalities. On the basis of experience gathered during this research project, a few issues could be highlighted. This small contribution may help developers of Atlas.ti to deliver an even more useful product. It may also help other researchers to work more efficiently with this tool.

The general issue was one of how to manage the conceptualized categories. Atlas.ti did not offer built-in support of this functionality and thus the researcher had to customize code families to generate a list of categories, which were, in fact, groups of concepts. Some of these could even be shared between many categories. That is why it is suggested that categories be presented in graphical forms which, in the case of shared concepts, could overlap each over. Such visualization could help to better manage the axial coding process.

Another problem related to axial coding concerns dependencies management. It was sometimes problematic to manage it from the Atlas.ti network-manager perspective. Network-manager worked with dependencies between codes and concepts and produced complex maps that were difficult to follow. The code family manager network view functioned as a filter showing portions of the entire codes and concepts network. This functionality was helpful but not sufficient as axial coding is interested in the dependencies between categories. Thus, the code family manager network could be supported with a new functionality which would also apply dependencies and visually manage them between code families – categories.

The next potential improvement is related to a coding process for transcribed text. It should be possible to highlight a few separate parts of a piece of text and mark them as a single code. Currently, it is only possible to mark one continuously highlighted piece of text in this manner.

Codes allow editing of associated comments. These comments were quite often copied straight from transcribed text. If this is done, then such commentary text could be hyperlinked to its source, rather than just copied, unless and until it is edited directly. This policy would effectively allow the use of the same piece of text in more than one concept. An update to the transcribed text would then automatically correct all hyperlinked commentaries.

While coding graphs, diagrams or drawings, Atlas.ti eventually becomes unreadable since coding leaves opaque frames on it. Thus the more information was contained on pictures, graphs or diagrams the sooner during the coding process it became unreadable.

Finally, a general remark should be made concerning the reporting system. It may be enough to add a simple and universal export interface that would treat all coded data as database fields. Such a simple creator could universally address a variety of data export needs.

Conclusion

Although many other issues could also be raised, the CAQDAS system was, nevertheless, supportive. It assured backwards traceability and linkages between data sources, backed cognitive thought processes and supported reflections. For a user who was aware of its limitations, Atlas.ti would certainly speed up data processing and avoid many human errors.

6.9.2 Reflections on framework development

Limited sample size concern

This section seeks to set out some of the considerations and review some of the concerns associated with the small sample size used in the research:

1. The research project used a pilot study, which allowed early verification of the existence of the phenomena under investigation and served to focus the direction of subsequent explorations.
2. A critical literature analysis helped to enhance the aim of the exploration process, not least by helping to select those interviewees best able to address the research objectives. Thus the interview sequence was initiated with two experts, each well-recognized in the field of PM.
3. Strict measures were applied to define who might be considered an expert (section 4.6.2), and a total of four experts were used within the sample.
4. The interviewees used for induction and conceptualization purposes were selected from a larger pool of people and companies. This was well-supported by making effective use of “Stream – 2”, enabling communication to be maintained with the PM community. Interviewee selection was closely managed through the course of the conceptualization process (Figure 12). Technically speaking, it was driven by opportunities to improve the saturation and trustworthiness levels of the conceptualization process and by directions of investigation that hadn’t yet been addressed.
5. Individual and group interviews were supported with other data sources such as, for example, documents, graphs, collected notes, long-lasting observations (OB3) and general PM community debriefings.
6. It was not intended *a priori* to use a smaller number of interviews. In the course of the research it became evident that the inductive strategy formulated was giving rise to rapid development of the conceptualization process.

7. While formulating the research strategy, the researcher paid specific attention to the context in which this scientific project took place. Thus the choice of an inductive approach "is more likely to be concerned with the context in which the events are taking place and might mean that a small sample is more appropriate than a large sample" (Collins 2010, p.43).
8. Saunders et al (2007) indicate that inductive research may be less concerned with the need for generalization.
9. For the problem of generalization, it is important to note that the framework requires a less normative but more descriptive character. This requirement was justified on the basis of 470 days of PM community debriefing, in which the request was repeatedly made neither to constrain nor overgeneralize the framework as its openness and ability to adapt were regarded by potential users as significant factors.
10. Over-generalization of the framework may limit its adaptability and provide excuses for many to refuse its use. A smaller sample in which related risks have been mitigated – achieved by making use of experts – serves to deliver a framework which clearly allows freedom of adaptation. Within "Stream – 2", the PM community forcefully pointed to three major aspects to be aware of: proposed tools, proposed contextual factors, and addressing the initiation complexity of the framework in respect of these tools and contextual factors.
11. The project's major deliverable, the framework, should remain open for further interpretation as required and as indicated during "Stream – 2". In focusing on research into PM, Pasian (2015) argues that "a loose or reasonably open-ended degree of interpretation is necessary, especially for an inductive approach" (p.247). Thus, open-ended conceptualization offers a good fit with the characteristics required of the framework and the sample size used.
12. The essential character of the research remains qualitative in nature. From this standpoint, interviews should not be considered as a quantitative "sample", even if within the conceptualization process significance level was controlled to some extent by numbers. The inductive, non-positivistic but qualitative and descriptive character of this work made use of interviews, observations, conferences and almost

continuous debriefing with PM practitioners. Achieving socially agreed understanding (Appendices 5 and 6) in this matter was considered the most effective and reliable way to assure certainty of the framework's future practical use.

13. Within research practice in the field of PM, methodology "developments in recent years show a trend toward integration of the researcher's own experience in the research process" (Drouin et al 2013, p.156) rather than, among other possibilities, increasing sample size. For this reason, the conceptualization process also considered the research project itself, as a case for making use of the estimation process. "Stream – 2" also assured a more interactive link to other areas of business knowledge. To some extent, this policy has the effect of "freeing the researcher from merely mechanistic roles, such as data mining in quantitative studies and coding in qualitative studies" (Drouin et al 2013, p.156).

Data collection and analysis process

Commencing the research process with experts allowed a list of codes to be rapidly built up and a reasonable view of the problem to be achieved quite early. The researcher was soon able to focus on network conceptualization. In measurable terms: after the first two experts P1 and M1, the number of codes and concepts was around forty; upon completion of the inductive reasoning process it was sixty-four. This part of the research strategy certainly increased the efficiency of combined data collection and analysis.

The idea of a research strategy which could be incorporated in some way into the daily work of the researcher was a conscious and ultimately successful choice. Opportunities to discuss the subject, speak at conferences and publish all came along almost unintentionally. Who – whether it is in budgeting, costing, scheduling or resource allocation planning – does not want to talk about their estimation processes? This policy also allowed a conscious choice of data sources.

This research is an example of an international project and raised questions related to the language used for the purposes of data collection. During the process it became obvious that there is less potential bias if one can communicate in the mother tongue of an interviewee. Such an approach neither limited wording and expression nor made interviews more formal. Of course, this implies that the researcher must master a number of languages. In practice, this was not a problem and it was sufficient to make use of Polish, German and English. Besides, interviews were largely about asking questions, then listening and observing. Nevertheless, translation for the purpose of citation was necessary.

Prior literature studying

As far as it addresses identification of potential knowledge gaps and the motivation for a research project, this point was highly important. Similarly, the initial set of questions remained influenced by written sources. However, the inductive nature of this project persuaded the researcher that there were also risks associated with prior literature analysis.

The researcher constantly had to keep control of his “own” view to prevent himself from moving in any predefined direction. He was sympathetic to the opinion that in some ways it would be better if he were to be “given” a research topic, and if literature analysis was only conducted after the creation of the project’s deliverables. Nevertheless, such a strategy could only be of partial assistance. The researcher is not inexperienced in PM and it seems unreasonable and unfeasible that he can “delete” or “hide” from himself aspects of his own previous experience.

Conceptual network and axial coding dependencies

The explorative approach applied required the identification of dependencies. A process of networking was conducted between codes and concepts as well as axially between categories and subcategories. The conceptual network remained highly complex and a large number of updates were also applied to it. This was also where most of the dependencies were discussed as well as types of dependencies changed. Simplifying, the axial coding represented a higher-level, more general category-based layer over the conceptual one.

The majority of thoughts and ideas were collected at the conceptual network level. It was influenced by application of the Atlas.ti tool and the degree of network detailedness. The researcher searched for a link between tools and contextual dimensions. These tools are found most often in codes and concepts, not in categories. A category might be recognized as a group of tools. This description is a simplification but it was a general impression collected out of the axial coding process. In more complicated situations, the framework tools were induced out of a few concepts even if they were located in more than one category. Then, it was necessary to go back and work directly at a transcribed text level.

6.9.3 Conclusion

The general conclusion was that the researcher focused on conducting the majority of work at a more complex conceptual network level, rather than at the axially coded one. Or, more accurately, both these processes were blended together. At the conceptual level it was possible to identify and verify the majority of tools. The "Methods able to increase accuracy of estimates" concept and the related category were major nodes within both conceptual and axial networks. However, if for some reason the researcher was unable to work for a period of time on the research project, axially coded material was very valuable, enabling traceability back to the data sources and the continuation of the cognitive thought process.

Given the choice again, the researcher would certainly pick up that same adapted research strategy and design. He would also follow a similar sequence policy of conducting interviews. However, observations would be used much earlier since they had a more "spontaneous" character. Use of CAQDAS system would be maintained – regardless of some limitations, it still had a positive effect on efficiency and helped order the research process.

The researcher became even more persuaded that research design must remain consistent with the contextual aspects of the research project as well as those of the researcher. This assumption is similar to the one that has been the backbone of this project deliverable, in terms of the direct linkage between project context and tools and techniques.

7 Research contributions, implications and limitations

7.1 Introduction

This chapter is dedicated to a brief review of all findings and a presentation of the contribution made to research and PM practice. In particular, in a dedicated section, it recaps the contributions of the framework to improving the accuracy of estimates. It also itemizes a set of reflections related to the inductive approach that was developed and thus the research design applied.

The motivation for this research project was primarily sustained by the researcher's own practice and findings collected during the pilot study. These demonstrated real duality in the estimation process for activities at the micro-level – revealing the presence of both overestimation and underestimation. Furthermore, the researcher's own PM-related observations indicated frequent, unsuccessful use of more prescriptive PMMs.

The researcher also discovered that the majority of the literature dedicated to CCM and BM focuses on the likelihood of overestimations or on contextually narrow investigations of a selected project or business sector. It was not difficult to collect data and find respondents complaining about the inaccuracy of estimates while, at the same time, not effectively using CCM and BM (PMI 2013, p.178). This was one of the reasons why the researcher became interested in investigating estimates as an indicator of general problems in managing projects. Contrary to situations where processes are repetitive, such as in the manufacturing sector, there was no calculation of close tolerance, or even potential deviation, offered up by any particular piece of well-described, predictable technology. Instead, there was just … an estimate.

This research sets out five objectives as described and explained in Section 1.5. The first was intended to enrich understanding of the phenomena of overestimation and underestimation. The second was expected to provide a major deliverable: a new framework for supporting a more realistic estimation process. The third concentrated on whether there is always a beneficial relationship between increased knowledge and increased estimation accuracy. The fourth directly addressed the CCM and BM methods to check whether there was scope for improvement. The fifth objective was to provide more insight into the question of whether one should better focus on techniques for improving estimation accuracy or, instead, try to apply more dynamic/agile-oriented approaches.

The achievement of these objectives was undertaken via the compliance with four associated assumptions, as discussed in Section 1.5.1. The research findings revealed that of these four, two of the assumptions were most pertinent to the success of this project:

1. The first (research assumption 1) was that recognizing a project's context was more important in the handling of PM complexity than the use of predefined, branded PMMs. Logically speaking, the approach taken to the improvement of estimation accuracy was based on the assumption that there is a link between contextual situations and the tools and techniques best applied to them.
2. The second (research assumption 4) was that the new framework created should be open to further development and not, therefore, restricted to any particular business sector.

The five objectives discussed were achieved by applying an inductive approach, briefly summarized in Sections 4.7.6 and 4.7.8. This could best be described as an iterative, explorative and inductive process managed by the conscious choice of the data sources used. During the cognitive process of analysis therein, numerous findings were identified which have been grouped and summarized and are briefly presented.

7.2 Key findings and contributions

Throughout this study process, key findings were identified. A new, *bona fide* framework was created while using the inductive approach which, together, also represented a unique research design combination. From this a number of useful, practical contributions were generated. Some of them addressed conclusions related to the research process while others addressed the five explicit objectives of the research and, thus, PM practice.

7.2.1 Implications for research

Pilot study input

A pilot study was started very early in this research project in order to consider the research problem raised, to address to some degree the researcher's own inexperience and to support discussion of the research design. It has shown that it is indeed possible to start qualitative investigation from deductive thinking (Murphy et al 1998). Nevertheless, in this particular research it appeared that the pilot study also nullified the need for wider employment of a hypothetico-deductive approach. This conclusion was not *a priori* of the planned course of action but rather *a priori* of the main consequence of the cognitive engagement that is characteristic of an inquiring research design. In the process of the pilot study it appeared that CCM assumptions were, in part, failing to address the phenomenon of inaccurate estimates and so an inductively designed explorative process took its place instead.

This observation indicated that the use of a pilot study as a method may be recommended for consideration as an early, valuable verification concept which is capable of both complementing subsequent discussion of the research objectives but also exploring the area of research design itself. Moreover, it may save on research costs by decreasing the risk of engaging resources in prematurely defined research design.

Last but not least, and alongside the implications identified in Section 4.3.7, it is worth sharing the well-rehearsed conclusion that the research project appeared to be influenced by the human nature of the individual researcher. This element should not be ignored given the comparatively long duration of the project and the care invested in its output. It emerged that a pilot study helps to early and efficiently verify whether the methods selected match both the researcher's personality and the constraints placed on the overall research context.

Research design

Firstly, the researcher discovered that increases in levels of trustworthiness and saturation must not be linear within applied inductive approach. This could effectively be managed by assuring a favourable contextual situation for the research project and by consciously controlling the sequence of interviews. A consistency of contextual situation with the research project seems to be a "must have" element, and the one primarily determining success. It may also be supportive to an earlier advance in saturation, giving easier access to data sources, to opportunities to present during conferences and to generally promoting the subject. In this respect, proper management of the sequence of the interviewing process increased the speed at which the framework evolved.

The roles of experts and practitioners differ, both from the perspective of their inputs to the research project and also in the improvement of accuracy of estimation. A practitioner's approach towards project context seems to be more focused on specific, chosen factors. Experts provide a more holistic view and cover more contextual elements though sometimes in a less detailed manner than practitioners. Experts were able to compare project cases across a much broader contextual perspective. Intensive interviewing and cross-questioning encouraged experts to search for arguments to justify their standpoints. Commencing an inductive reasoning process with an expert on-board accelerated understanding of the phenomena being observed. However, because of the differences in the characteristics of practitioners and experts, cooperation between them in a project's context-focused research seems to be necessary.

Furthermore, observations provided a whole spectrum of opportunities to verify findings during group interviews and more unstructured discussions. They also expanded or adjusted the design of the research. For example, observation OB3 lasted two years and to a large extent took on the character of a longitudinal study. The observations also served to keep the researcher focused and "sharp",

with the practice of open and spontaneous communication acting like a “machine” and pulling fresh data and events into the project.
Secondly, irrespective of the increasing complexity of the conceptual network and the conceptual analysis, the application of a CAQDAS system was fundamental to maintaining technical control of the various data sources involved. In this respect, recorded video material, graphs and diagrams proved to be superior to audio recording and hand-written notes, enabling “what was said” to be additionally verified by seeing “how it was said”. Even given the issues encountered within Atlas.ti and described in Section 6.9.1, dedicated software made the entire analysis less prone to human error. By assuring a much greater degree of order and rigour, such software allowed the researcher to focus on the core research rather than on seeking whether “where?/what?/who?” furnished any particular piece of information. What might be considered more debatable, however, is the issue of Atlas.ti having its “own approach”, one that is – technically speaking – very networking-oriented, which must be taken into account when using it.

The following points provide additional reflections regarding the implications for the design of applied research:

1. Conducting a literature analysis prior to making use of inductive process may be, to some extent, regarded as a risk factor. As far as it referred to motivation, identification of the researcher’s own confusion, searching for gaps in business knowledge, and underpinning potential contributions, it was advantageous. However, there was a residual risk that the framework formulation process might be influenced and even subconsciously skewed in a direction predefined by the literature. The researcher should, in fact act simply as a “tool” in order to protect the open-minded exploration.
2. The list of questions (Table 4) used initially was of lesser importance than had been assumed. It was useful as a starting point but the inductive approach itself became the process that identified ambiguous answers or contradicting points of view. Through verification of the significance level of codes and concepts and evolution of the conceptual network, a scientific inquiry was undertaken in order to better support increases in the saturation level.

3. It appeared that the detailed, conceptual network eventually became more useful than the generalized, axially coded one. This conclusion may be a result of the focus placed on the formulation of the framework, which required a more detailed search for tools and techniques and their dependencies on the contextual world of projects. Nonetheless, the axial network was able to show more general dependencies between categories and subcategories.

Research projects

The researcher continues to promote contextually focused discussion. In view of the thesis' limitations discussed in Section 7.3, it appears to be reasonable to continue the process of investigation. According to Morris (2013), the validity of PM "knowledge is affected by the context in which management is operating and the values and behaviours of those involved" (p.20). Thus, new investigations could initially be proposed.

Firstly, it would be interesting to validate findings in more experimentally oriented research designs. For example, it might require there to be at least two similar projects undertaken that had similar contextual conditions, with just one of them having the framework applied.

Secondly, it might be tempting to make use of longitudinal observation. This approach could involve the same employees working at the same company for a relatively long period of time in order to help maintain consistent conditions during the framework's implementation. A longitudinal case study approach similar to the one used by Hussain and Hafeez (2011) could be adopted. Hussain and Hafeez (2011) demonstrated that such a research strategy helps to develop contextual awareness, is interpretivist in nature, focuses on social constructs and context, and can be applied efficiently to the analysis of real life projects (Constantinides and Barrett 2006; Orlikowski and Baroudi 1991; Wagner and Newell 2006; Walsham 1993), and it is thus aligned to many of the distinctive components of the framework induced during the current work.

In addition, the current research project found frequent focus on the duality of overestimation and underestimation present at the micro-activities level. Therefore this aspect demands additional research in order to develop a mathematical model able to manage negative buffers as well as inflated positive ones. This would enable further development of the debate initiated in Section 6.6.2.

Furthermore, the research design was employed to induce a framework whilst avoiding formulations of theory. Future research could make use of a wider range of data sources – for example, quantitative in addition to qualitative – and thus seek to reformulate the framework into true academic theory.

From the perspective of accuracy of estimates, this research confirmed that besides the "value of knowing", there is also the "value of not knowing". Nevertheless, from the perspective of KM, many key elements of the framework should form the base for further improvement. For example, its context awareness and self-adaptation "mechanism" depends strongly on the overall learning process. Thus, the quality of this latter could be further analysed from the perspective of the ethically considered principles of action learning (Johnson 2010), in order to make the idea of the learning process more complete and compelling for potential consumers while maintaining, or critically assimilating, the qualities of Revans' (1998) teachings.

Action learning principles (Pedler et al 2005), however, do seem to take analysis to a more individual level than the more collective level that is typical of the lessons learned process. In the view of the researcher, this should not be perceived as a mismatched characteristic and one might investigate how action learning can help an individual to better prepare beforehand for a lessons learned process, as well as during and after it. That said, it is worth emphasizing that this thesis often took readers to the micro-activities level in order to discuss accuracy of estimation and, at this level, problems are often perceived to be more individual in nature.

Further research is also required into the cultural differences that embed context and which could therefore provide an interesting field for future investigation, allowing existing conclusions to be expanded beyond the “western” hemisphere.

In the final reflection, and fortunately for many of the potential research ideas, the framework displays an interesting and valuable characteristic: validation and testing of the framework does not determine whether it should “live or die” but, instead, and as long as the process is properly managed, serves to inherently improve it.

7.2.2 Implications for practice

Framework contribution to PM practice

A framework for increasing the accuracy of estimates was the goal of this research project achieved in Section 6.4. Its formulation brought a lot of opportunities to communicate it to the wider PM community and to verify that a socially agreed understanding of it had been achieved. The researcher is deeply grateful for having such an opportunity to present his ideas during conferences and also communicate with PM practitioners during organized meetings (as represented in Figure 12, “Stream – 2”). The framework gives rise to a number of implications for PM practice.

Firstly, the approach proposed differs in several ways from traditional PM as supported by branded PMMs. At the beginning of the project lifecycle it makes extensive use of context complexity to configure use of tools and techniques, and to structure a methodological approach that is specific to the project concerned. The proposed framework allows one to work directly with project context as observed rather than to some practitioners’ abstract PMMs, driving the selection of tools to provide a better fit with the particular project’s context. It seems that this approach may be more effective in improving accuracy of estimates than one based on more prescriptive approaches to PM.

Secondly, through making use of a team's knowledge, it achieves their early engagement. Thus, the framework directly enhances its users' motivation and also makes use of project-induced knowledge. By shaping its form and becoming "insiders", practitioners become "shareholders" in the framework. The opportunity to participate can stimulate interest in the subject with the lessons learned process helping to initiate and sustain its subsequent evolution, understood as the progressive adjustment of tools and techniques to the specific contextual situation. Moreover, the "right" to decide what constitutes PM knowledge is less subject to the policies of PM organizations or the content of PMBOK-defined knowledge areas, and is returned to the source of knowledge creation, i.e. the projects themselves, their teams and their stakeholders.

The framework characteristics associated with these first two implications are further supported by a practical description, comparatively unique, of know-how to apply guidance, presented in Section 6.4.8. This adaptable framework implementation guidance is sensitive to context, users and project methods.

Thirdly, the framework is more of an open idea than a closed set of contextually dimensioned tools. Thus, given appropriate care, it anticipates its own further contextualization. It defines a common methodological platform which to some extent eliminates unnecessary conflicts between paradigms or discussions of which PMM is "better". On the other hand, the flexibility of the framework does not prevent the possibility of defining which of its tools might be either recommended or optional, for example, to reflect best fit to a specific business sector. The framework may initiate or contribute to a debate regarding the unification of PMMs – methodologies which, on the one hand, may recognize the existence of project context but, on the other, could be "victims" of a focus placed on methodological brand names rather than on the use of specific tools conditioned by that context.

In light of the literature analysis, the framework helps in practice by not being predominantly influenced or pre-programmed by assumptions of having the overestimated or underestimated projects typical to some business sectors such as, for example, the public sector (Williams and Samset 2010). Besides the macro-project perspective, the framework takes discussion down to the micro-activities level, where the potential duality of an estimate's bias can be analysed through the more precisely addressed observations made at this level.

Finally, the framework and its know-how to apply guidance define and exploit a unique group of practices for enhancing realism of the estimation process. The key, synergistically interrelated characteristics of the framework were formulated into the following list:

1. Priorities should be managed at both micro-activities and macro-milestones levels. It seemed that sustaining estimates made at macro-level can positively influence estimates at the level of micro-activities. Since consistent priorities were generally critical to subsequent estimation process, then ensuring that high priorities are established in support of macro-level estimates was more important than embarking on a detailed estimating at the outset.
2. Multitasking has a dual aspect. On the one hand, preparation for it should be made through the development of a range of competences. On the other, however, the need to make use of it should be minimized as standardizing processes decreases the need for, and frequency of intellectual setup. If it is not possible to decrease multitasking then other supporting and enforcing tools could be applied. Within this research project, the "quiet hours" method was identified as an example of such a tool.
3. Competences should be made and kept visible. The more multi-project the work, the more transparency of competences may have to be applied. This conclusion had very solid roots, being embedded in the long lasting OB3 observation. Such transparency helped to stabilize the results derived from the estimation process.

4. Within any organizational structure, knowledge hubs should be established – and publicized – to ensure access not just to information but also about where the knowledge is actually held. The form that such hubs should take was not explicitly determined.
5. Experts should be present not only to support knowledge sharing but also because they provide points of reference by which deviations between planned and executed estimates can be interpreted. Thus, experts provide valuable support to the lessons learned process.
6. The sequence of the estimation process should be aligned to the business constraints identified. It must not be resource. These might be time or scope but one should remember that they could also be any other "decisive element".
7. Gaining acceptance of the framework from the project's major stakeholders is advisable for sustaining improvement in the accuracy of estimates. Additionally, in large organizations and/or in multi-project environments, major stakeholders should have access to the project plans of all subcontractors involved. Without this, communication processes may not be aligned to schedules and decisions taken may adversely affect the accuracy of estimates and potentially result in underestimation.
8. Communication channels should be shortened and their number should be reduced. Someone may not know something simply because of the low efficiency of a communication channel. The assumption that communication is generally good for PM ends up with the question "what communication?" as key messages fail to traverse complex networks.
9. There are no "good" or "bad" IT tools. There are only those which do or don't correspond to a project's particular context and deliverables. However, this does not call for development of IT tools specific to each project but, rather, indicates that each should offer a wide spectrum of functionalities that can be subject to individual, project-dependent parametric configuration.
10. From the perspective of improvement of accuracy of estimates, branded PMMs should principally be used for the purpose of initial, entry-level education. They may, of course, also be made use of if contractually required.

In relation to the framework's tools and techniques, it is feasible that they should be implemented in interrelated groups. Within the analysis, this was suggested by dependencies established within the conceptual network and communications conducted with the PM community. Although many of the individual methods that were considered were by no means new to business application, their synergistic drawing together in support of particular contexts, certainly was.

Placing the focus on methods and project context seems to be practically advisable since it appeared to be more natural than one based on abstract abbreviations, acronyms, terminology and PMM brands. During contextual discussions, interviewees often broadened the perspective beyond the projects being discussed, so much so that the framework might, to some extent, also be considered capable of mediating changes to other areas that are coincident with PM.

Estimation process

In the first instance, this project allowed the researcher to improve his own understanding of the estimation process and its value in PM. Alongside the framework, and while responding to other objectives of the research, a number of additional contributions were accomplished.

Firstly, it was established that underestimation exists alongside overestimation at the micro-activities level of analysis, albeit that underestimation was identified in fewer cases than overestimation. Nonetheless, the logical conclusion is that – in the CCM and its associated BM (PMI 2013, p.178) – negative, underestimated buffers should be afforded the same level of recognition as developed from assumed "safety margins", positive ones. Summarized, positive and negative buffers may appear to be smaller. As the pilot study confirmed, it is possible that even in the course of reducing a set of summarized (negative and positive) buffers, instead of promising earlier milestones it may be more sensible to warn of, and re-discuss, a later finish date for the project through the application of such a modification of BM.

Due to the influence that PMMs have on PM practice it may be advisable to make their descriptions less prescriptive and encourage the consideration of various scenarios in the use of BM. For example, rather than discussing the question of macro-level overestimated or underestimated projects, the term “schedule stability” may be a more practical and neutral description for the approach to the problem of inaccuracy of estimates. At micro-activities level, the stability of a schedule decreases as the number of overestimations and underestimations increases. Moreover, PMMs generally favour more straightforward BM scenarios in which duration buffers can be added to a schedule (PMI 2013, p.178). In practice, though, project deadlines may exist *a priori* and then the schedule must fit into the timeframe available. In such scenarios, placing the focus only on inflated activities may be unrealistic.

As a result of its potential impact on costs, the implications for PM practice could be extended to labour and other types of cost estimating (tendering and negotiating processes, subcontracting, the setting of credible milestones to reduce the risk of contractual penalties, profitability forecasting) or – more simply – the support of personal time management. Thus a wider audience of investors, financial officers, project sponsors and contractors may find aiming for improvements in accuracy of estimation and this project’s context-driven framework as concepts worthy of their attention. After all, estimation affects budgeting and, through this, future cash flow, affording value both immediately and, in the longer-term, to shareholders. This combination of the importance of bias reduction in estimates and the universality of the approach proposed may thus address not only PM but also new niches within business.

Secondly, it seems that the apparently “obvious” dependency between increases in experience and increases in accuracy of estimates should be carefully considered. Surprisingly, it appeared that it may be possible to be over-experienced as well as under-experienced. One idea to solve this dilemma may lie in the team acquisition and development process, with the notion of seeking a balance in the competences, experience and age of team members. It may also be possible to “convert” practitioners into experts.

Thirdly, the decision-making process that frequently surrounds whether one should apply a traditional or more flexible, agile methodology may be irrelevant. This view can be sustained as long as the situation is analysed from the perspective of tools and techniques, and in a work environment supported by effective KM and lessons learned principles. It seems that placing focus only on PMM labels may introduce confusion to cognitive processes that have been based on a practical response to the context observed for the project.

Moreover, hybrid (Binder et al 2014; Špundak 2014) and other variations of traditional and dynamic/agile approaches might be considered by practitioners as a pre-selected and named set of tools from the outset. However, if project context acts as the primary influence on this then any configured toolset may be deemed hybrid. Then the rhetorical question might arise: is hybrid an example selected from the infinite file of possible contextual configurations?

Finally, from the point of view of improvement in accuracy of estimates, “super-stable” schedules should be considered as a potential sign of problems. A zero bias in estimation accuracy is very unlikely to be achieved and the lack of any such residual volatility may indicate the presence of inefficiency. It may be the result of hidden and “consumed” overestimation, use of over-extended resources, or other potential factors. In addition, the data collected indicates that there are some particular cases where the amount of legal regulation and/or other constraints effectively disables any possibility of improving the accuracy of estimates in an efficient fashion. Some examples of this were found in the public sector.

7.2.3 Literature perspective

In Chapter 2 and Section 6.8, numerous bibliographical references were provided in the course of the critical review of associated literature sources. The following points briefly recap the major themes in order to reflect on the research findings in the light of the literature, and the knowledge gaps identified. They are organized on the basis of the sequence of the project's five objectives:

1. If the available papers discuss accuracy of estimates, then it is typically in the context of a specific case or business sector. Thus recognition of a wider range of contextual configurations that might cause underestimation or overestimation is limited. The papers often choose to focus discussion either on underestimation or on overestimation and, to some extent, prefer to take a macro-project level perspective. For example, the public sector is considered in order to represent underestimated projects. This has the potential effect of limiting more heterogeneous applications, as well as a broader recognition of their conclusions, in the PM marketplace. Thus, it may constrain the possibility of achieving a widespread, socially agreed understanding across a wider range of business sectors.

   The present research seems to cover this gap and to allow the continuation of open discussion of the existence of underestimations and overestimations at the micro-activities level, and their contextual conditioning, unconstrained by any business sector. The scarcity of papers sharing the characteristics of this thesis and, at the same time, considering this duality in the bias of estimates from the perspective of the estimation process and contextual factors that influence them is clearly apparent. It has become possible to maintain a broader discussion of the contextual factors causing underestimation or overestimation while still aiming for practical research project output.

2. Many frameworks identified in the literature base their discussion on complex mathematical models that have been locally valid or tested, which may constrain their versatility. The conclusions of this thesis found much similarity to “critical schools” and the new trends in PM that they indicate, particularly when it comes to conducting PM in less prescriptive ways. Morris (2013) indicated that adaptable approaches to PM will play a major role in the future. Adaptability to project context appeared to be the proposed framework’s most vital characteristic.

   In addition, its know-how to apply guidance has more open and descriptive content. The research contributes to “critical schools” and through its major deliverable helps to cover the gap in the practicality of this discussion. It becomes noticeable that configurable approaches may find a practical implementation by using a framework focused on the analysis of project context and anchored in the estimation process.
   It must be acknowledged, however, that the proposed framework primarily makes use of project context as a form of inert input information, whereas “critical schools” papers also debate the possibility of actively reshaping such project context too.
3. A common defining element of many papers, confirmed as well by this thesis, is that the effectiveness of KM is highly context- and people-driven. The research project has enriched the literature around KM, particularly in respect to the relationship between knowledge and accuracy of estimates. Surprisingly, it was identified that use of knowledge cannot be discussed solely from a beneficial perspective focused on analysis of its explicit or tacit characteristics. It seems that in some contextual configurations being over-knowledgeable may result in estimating bias, typically overestimation. Thus, contrary to many recent papers, and picking up on older academic discussions, the “value of not knowing” may very well exist.
4. There are numerous papers that critically consider CCM and its BM, often trying to improve the sizing of project buffers. It should be highlighted that they, for the most part, do not give attention to the market weight of CCM especially when considering applied research designs. In contrast to this, the present thesis repeatedly communicated its findings to the PM community to verify a social understanding. The result of this was not

another criticism of the method per se, but rather a suggestion for changes that could be characterized by two aspects.

Firstly, in BM, underestimation should be considered alongside overestimation in order to enhance the debate over the sizing of buffers to protect project milestones. Secondly, in practice, a project completion date is often just given, instead of being calculated by adding buffers to activities. Adding only positive buffers to the schedule in this way in order to propose a project completion date would seem not to be consistent with all project cases. Thus, it may require re-definition or extension of the possible starting point for BM analysis.

5. Even if papers take a position on whether to follow traditional, dynamic or more mixed/hybridized approaches, the last objective brought the conclusion that this academic debate may be misleading, at least if considered from the perspective of there being a choice between improvement or management of an expected lack of accuracy in estimates. For example, in the course of the cognitive process the researcher became interested in hybridized approaches until he realized – while communicating with the PM community – that examples of “hybrids” are countless. There appeared to be numerous examples of configuring answers to sample-project contexts through method selection; and this was also the case when considering the use of traditional or more dynamic/agile “schools”, configuring to more or less the emergent nature of projects.

   The research suggests that being a reflective practitioner and making effective use of lessons learned may allow one to decide how to proceed at the level of tools and techniques. It may remove the need to choose whether someone should seek to improve the accuracy of estimates or simply start to manage an expected lack of accuracy. Surprisingly, it may be that both policies may be pursued at the same time.

7.3 Limitations

Despite the researcher's carefully organized approach towards this project, there were some limitations related to the findings and research design and these are described below.

7.3.1 Limitations of findings

The researcher has found that a framework is capable of evolving into a powerful tool. However, as it stands, it is not an unconstrained "panacea". Firstly, the types of dependencies used to conceptualize the framework were not always "evident". A careful approach was applied but the researcher still has some reservations. One particular type of dependency was not used very often within the framework: it was presented in Section 6.4.8 as "-", and advises the framework user to "avoid this tool". Further analysis should be undertaken to establish whether there should be more such "avoid" situations. Secondly, the contextual dimensions did not cover the financial sector. A service sector was present but it seems that, due to its significant market weight, the financial sector should be afforded more individual consideration.

Furthermore, this project was conceptualized on a limited number of interviews. Therefore, although it was supported by use of holistic input from experts, some long-running observations and maintenance of frequent, wide-ranging contact with the PM community, the framework should be applied cautiously with the support of a lessons learned process and the results should not automatically be applied to other projects, even if they are justified as having "similar" contextual situations.

Moreover, the framework neither discussed the sequence nor groups of application, despite the fact that the latter element, in particular, appeared to be a feasible aim. It somewhat inhibited the synergistic effect of the tools contained within the framework. Finally, there are probably contextual configurations where the use of the framework for the improvement or management of estimates may be impractical, mainly due to legal requirements and/or a large number of other constraints. Some such cases were, for example, identified in the public sector.

7.3.2 Trustworthiness of the analysis

Looking from the perspective of Guba (1981) and Lincoln and Guba (1985), the credibility and dependability within an inductive approach can be efficiently assured. It seemed that generalizability and, thus a definite level of transferability, could prove more problematic. For example, in order to be able to claim that the framework's transferability is unconstrained, the contextual dimensions and methods associated with it should be unconstrained as well. These effectively provide an indication of the framework's level of specificity. Where is the limit? It was very difficult to clearly define it. Certainly, a framework that is too detailed would decrease its applicability to business practitioners, mainly due to excess complexity. Where is the balance? It could, potentially, be identified by testing this framework in the field.

One of the assumptions for this research project was that any framework developed would become an open "platform" and thus subject to further development. This development, however, should not be considered as an unlimited extension of the framework but rather as part of its progressive clarification and verification through application to real businesses. Confirmability (Lincoln and Guba 1985) has taken its first steps in the conceptualization process conducted. Nevertheless, it seems that an additional research project with a different, more experimental research design could be productively undertaken.

7.4 Closing thoughts and reflections

Despite the limitations described, this entire project has allowed the researcher to learn more about PM practice and to develop his own business and scientific skills. Theoretical sources and research methodology were useful in establishing that it is possible to work efficiently at the level of tools and techniques without the enforced perspective of one or more PMMs. It was possible to swap PMMs for two terms – project tools and project context – in what appeared to be a powerful, adaptable composition. It was also demonstrated that inaccurate estimates may be considered as the common starting point for a number of best practices within the PM business knowledge area. Through observing the bias in estimation processes, it also described some of the essential differences between PM and repetitive processes, and considered practical use of the underestimations identified, in conjunction with the more customary overestimations.

The researcher hopes that the proposed framework will, indeed, be proved open and will support discussions regarding the unification of PMMs and, in addition, help to even more closely associate "critical schools" with current business practice. An on-demand "PMM" can be achieved by constructing a response to the existing project context. The framework is the beginning of an answer as to how to do this efficiently. It may help practitioners to make sense of existing project contexts and better equip them for dealing with the selection of potential tools and techniques. It may also serve as a starting point for other researchers to continue investigation into the problem of inaccurate estimates that is so fundamental to PM. Aiming to reduce the inaccuracy of estimation is part of the planning process and we should continue to endeavour to find a better way of estimating.

"Plans are nothing; planning is everything."

Dwight D. Eisenhower, 1890-1969

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Appendices

Appendix 1: Survey – pilot study

Survey – pilot study

UNIVERSITY OF BRADFORD

Dear respondents,

This survey is a part of my doctorate research project (Doctorate of Business Administration) on Project Management. My work is conducted with the cooperation of Bradford University in the United Kingdom and TiasNimbas Business School located in the Netherlands. The results of this questionnaire will be processed for the sole purpose of scientific research. Participation in this survey is entirely at your own discretion and is without obligation.

After the collection of your valued information and its subsequent analysis, it is intended to organize a follow-up – focus group discussion. Attendance at this will, again, be entirely at your discretion. It will take the form of an unstructured interview.

<u>Please note:</u>

1. By filling in this questionnaire you agree to enter the survey of your own free will.
2. You complete the survey anonymously, and will not be asked to provide your name, surname or any other personal data.
3. All data collected will be treated as anonymous and confidential – survey forms will be scanned and kept digitally under 256-bit encryption.

I greatly appreciate your help.

Adam Lazarski
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- What is your gender? (F/M)
- What is your formal position in the company? …………………………………..
  ………………………………………………………………………………………...
- Are you involved in directing projects as a project manager? (Yes/No)
- Are you involved in participating in projects as a team member? (Yes/No)
- Have you ever worked as part of the Project Management Office regardless of acting there as manager, team member or project manager? (Yes/No)
- Are you in any way rewarded for accomplishing your projects/activities before due dates? (Yes/No)
- Are you in any way punished for exceeding deadlines in your projects/activities? (Yes/No)
- What factors primarily influence your estimates for the anticipated duration of your activities? …………………………………………….……………….
  ……………………………………………………………………………………..….
- If you were to be asked to change something in your motivation system what would it be? ………………...……………………………….……..…………...
- How would you best characterize your current motivation system? (give a short description, e.g. keywords describing it) ……………………………..……
  ……………………………………………………………………………………..….
- In what percentage of your activities' duration estimates do you feel that you tend to overestimate? (0-100%)
- In what percentage of your activities' duration estimates do you feel that you tend to underestimate? (0-100%)
- What percentage of your activities is challenged by your supervisor in order to reduce its duration? (0-100%)
- What, if anything, were you afraid of when you got involved in the project? ...
  ………………………………………………………………………………………...
- On a scale from 1 (I hate it) to 10 (I love it), what number would you choose to characterize your enjoyment of being involved in the project in your company?
- Would you be prepared to participate in a short focus group discussion (group interview) with reference to the questions raised above? (Yes/No)

Appendix 2: Data gathered during pilot study

Data gathered through the survey was quantified into the following table by use of the following rules:

1. Answer “Yes” was quantified as 1.
2. Answer “No” was quantified as 0.
3. Answers related to percentage (0-100%) scale were used exactly as collected.
4. Answers related to (1-10) scale were used exactly as collected.
5. Answers given to open questions were neither quantified nor categorized, but listed exactly as collected.
6. “?” – question mark indicates that no answer was given or it was illegible.

Company?	P	P	P	P	P	P	P	P
What is your gender? (F/M)	M	M	M	M	M	M	M	M
What is your formal position in the company?	Team manager	Specialist IT	Specialist IT	Sales support Eng.	Section director	Projects specialist	Team leader	System administrator
Are you involved in directing projects as a Project Manager? (Yes / No)	1	0	1	1	1	0	1	0
Are you involved in participating in projects as a team member? (Yes / No)	1	1	1	1	1	1	1	1
Have you ever worked as part of the Project Management Office regardless of acting there as manager, team member or project manager? (Yes/No)	1	0	0	0	0	0	1	0
Are you in any way rewarded for accomplishing your projects/activities before due dates? (Yes/No)	0	0	0	0	1	0	0	1
Are you in any way punished for exceeding deadlines in your projects/activities? (Yes/No)	1	0	0	1	1	1	1	1
What factors primarily influence your estimates for the anticipated duration of your activities?	Problems with know-how	Experience	Experience	To win contract must meet the deadlines	Long time of taking decisions	?	Time	Complexity of a certain task
If you were to be asked to change something in your motivation system what would it be?	More flexible, connects with success	Get to know it	Relating it to success	Defining multi factor motiv system related to everyone	Set motiv. system on elements which I can influence	Any relation to success	Relate project goals to financial Incentives	Clarifying it
How would you best characterize your current motivation system?	Not motivating	I do not know it - not presented	No motivation system	Only sales oriented	Department result divided - not individual	Unclear	Cannot influence on KPI defined success fee - around 80%	Satisfaction, creativity, developement
In what percentage of your activities' duration estimates do you feel that you tend to overestimate? (0-100%)	10	100	30	50	75	40	50	60
In what percentage of your activities' duration estimates do you feel that you tend to underestimate? (0-100%)	10	20	50	10	20	60	50	20
What percentage of your activities is challenged by your supervisor in order to reduce its duration? (0-100%)	?	30	20	50	10	30	30	20
What, if anything, were you afraid of when you got involved in the project?	Team members demotivated, they are overloaded for nothing	Overtime work without being awarded	Change of scope during developement phase	Responsibilities ans lack of power to influence working teams	Cannot influence budget and human resources	Uncontroleld scope change and crossing due dates	Lack of influence on other department	Unclear scope, lacking quality solution
On a scale from 1 (I hate it) to 10 (I love it), what number would you choose to characterize your enjoyment of being involved in the project in your company?	5	5	5	2	8	6	4	8
Would you be prepared to participate in a short focus group (group interview) discussion referring to the questions raised above? (Yes/No)	1	1	0	0	1	1	0	1

Company?	T	T	T	T	T	T	T
What is your gender? (F/M)	M	M	M	M	M	M	M
What is your formal position in the company?	Software Eng	Team Leader	Software leader	Software Eng	Software Eng	Software Eng	Software Eng
Are you involved in directing projects as a Project Manager? (Yes / No)	0	1	1	1	1	1	0
Are you involved in participating in projects as a team member? (Yes / No)	1	1	1	1	1	1	1
Have you ever worked as part of the Project Management Office regardless of acting there as manager, team member or project manager? (Yes/No)	0	0	0	0	0	0	0
Are you in any way rewarded for accomplishing your projects/activities before due dates? (Yes/No)	0	0	0	0	1	0	0
Are you in any way punished for exceeding deadlines in your projects/activities? (Yes/No)	1	1	0	0	0	0	0
What factors primarily influence your estimates for the anticipated duration of your activities?	Experience	Complexity of the estimated task	Changing scope	Complexity	?	?	Experience
If you were to be asked to change something in your motivation system what would it be?	To create it	Bonus for earlier accomplishments	Bonus for succesful projects	Satisfaction, success fee bonus	Make it target oriented	?	?
How would you best characterize your current motivation system?	Praised: "good job!"	Does not exist - annual evaluation and potential salary increase	Does not exist	?	Have fun and money from my work	Bonus based on principal's opinion	Self motivation and praised "good job"
In what percentage of your activities' duration estimates do you feel that you tend to overestimate? (0-100%)	30	95	20	30	10	20	5
In what percentage of your activities' duration estimates do you feel that you tend to underestimate? (0-100%)	60	5	30	10	30	10	5
What percentage of your activities is challenged by your supervisor in order to reduce its duration? (0-100%)	10	10	10	5	10	2	0
What, if anything, were you afraid of when you got involved in the project?	Incompetence and uncontrolled processes	Scope not finished, crossing deadline	Aggresive schedule	Competitive to me person responsible for relations with customer	If I am able to manage this	Crossing deadline	If others will accept ideas i.e. improvements
On a scale from 1 (I hate it) to 10 (I love it), what number would you choose to characterize your enjoyment of being involved in the project in your company?	7	8	6	6	8	7	7
Would you be prepared to participate in a short focus group (group interview) discussion referring to the questions raised above? (Yes/No)	0	1	1	1	0	1	0

Appendix 3: Template for taking notes and observations

Place and date:		
Title:		
Biased? Tick if Yes	**What happened?**	**Commentary and reflections**
☐		

Appendix 4: Categories, subcategories, significance level and concepts

Sig – header stands for significance level. Its number, measured by Atlas.ti, shows how many times the associated concept was identified in the transcripts.

Categories	Sig	Subcategories	Sig	Concepts
C. – Methods able to increase accuracy of estimates	72	C. – Me., Subcat. – Scheduling method	25	Estimation process sequence should depend on identified constraint
				Milestones and deadline oriented schedule
				Parametric tools and standardized methods/processes
				Too stable schedule is not credible
		C. – Me., Subcat. – Software and database support	10	Dedicated IT tools (functionalities are consistent with deliverables and project context)
				IT databases support estimates when parametric models are used
				Simple IT tools and limited access to sophisticated ones
		C. – Me., Subcat. – Use of traditional PM methodology	16	Methodologies are used to support immature organizations
				Methodology should correspond to a project and its context
			1	Effect of best and wrong practices
			14	Methods able to increase accuracy of estimates
			6	Reduce complexity of communication channels
C. – Priorities management	24	Intellectual setup – multitasking		
		Intensity of change		
		Quiet hours		
		Stability of priorities		
C. – Expected personal profile	98	C. – Exp., Subcat. – External and internal stakeholders	24	Customer/stakeholder focuses on global estimates
				Customer/stakeholder is part of the process and accepts methodology
				Customer/stakeholder should see combined plan of all involved parties
				External stakeholder in over-formalized work environment
				Internal stakeholder
		C. – Exp., Subcat. – Team members and project managers	74	Age and experience
				Competences should be transparent
				Frustration
				Introduction to a job position and responsibilities

			Less experienced are estimating only on the basis of a description of functionality
			Not every team member is capable of working in PM environment
			Overly optimistic
			Overly pessimistic
			Personal characteristics may not allow an increase in accuracy of estimates
			Questioning expert's estimate results in a loss of morale
			Relationships between team members
			Role of an expert
			Overly experienced have tendency to overestimate
C. – Role of lessons learned in KM	53	Access to information and history	
		Knowledge hub	
		Knowledge is hidden in lessons learned – one’s own and shared	
		Lack of technical know-how	
		Misunderstood or wrong know-how	
		No significant bias in engineering, if scope is well known and know-how is verified	
		Insufficient knowledge of scope of activity	
		PM certification is a business product for sale	
		Successful projects regarded as an example of accurate estimating	
C. – Flexible planning	7	Abandon detailed estimating and try to fit into scope during execution phase	
		Do not estimate what is unknown	
		Projects with scope to be defined during a project life cycle	
		Work with rolling-wave planning	
C. – Losing business focus	5	Focus on business goal and not on a product goal	
		Focus on lessons learned KPIs and not on business goals	
		KPIs should be removed from lessons learned	
C. – PM environment context	48	C. – PM., Subcat. – Industrial sector	Choice of agile or traditional PM approach depends on the project characteristics
			Consulting services sector projects
		C. – PM., Subcat. – Internal and external projects	Context-dependent, known methodology does not exist
			Duality in decision-making process
		C. – PM., Subcat. – IT and service sector	Elections and change of sponsor
			Elections at a local level
			Imposed and unverified deadlines
		C. – PM., Subcat. – Large and small organizations/ projects	Unlikely in public sector projects
			Industrial, engineering and construction sector projects
			Is bias assumption that obvious?

		C. – PM., Subcat. – Public and education sector	IT and service sector projects
			Multi-project-assignments work environment
		C. – PM., Subcat. – Single or multi-project-assignments work environment	Parameters that cannot be controlled
			Public and education sector projects

Appendix 5: "Stream – 2" the list of conducted meetings

The table below catalogues all of the meetings conducted and contractually regulated, which provided the opportunity to maintain an ongoing process of PM community debriefing. It contains 425 days of meetings dedicated to improving the understanding of a wide range of specific PM tools and techniques and 45 days spent in one corporation – observation OB3. Synopsis of the major data collected is presented in Appendix 6.

ID	Date	Days	Major topic or data source
1	5-7.08.08	3	PM planning processes
2	3-5.09.2008	3	PM planning processes
3	21-22.09.08	2	Planning processes for portfolio and programme management
4	29-30.09.08	2	PM planning processes
5	6-7.10.08	2	Estimating and budgeting
6	13-15.10.08	3	Planning processes for portfolio and programme management
7	16-17.10.08	2	PM planning processes
8	27-29.10.08	3	Planning processes for portfolio and programme management
9	30-31.10.08	2	Planning processes for portfolio and programme management
10	5-7.11.08	3	Processes stability improvement
11	13.11.08	1	Estimating and budgeting
12	26.11.08	1	Knowledge management, lessons learned process
13	27-28.11.08	2	Best PMMs practices
14	3-5.12.08	3	Processes stability improvement
15	9.12.08	1	Knowledge management, lessons learned process
16	13.01.09	1	Knowledge management, lessons learned process
17	22-23.01.09	2	Estimating and budgeting
18	9-11.02.09	3	PM planning processes
19	23-24.02.09	2	Estimating and budgeting
20	25-27.02.09	3	PM planning processes
21	2-3.03.09	2	Estimating and budgeting
22	18-20.03.09	3	Processes stability improvement
23	23-24.03.09	2	PM planning processes
24	1-3.04.09	3	PM planning processes
25	23-24.04.09	2	Planning processes for portfolio and programme management
26	27-29.04.09	3	Knowledge management, lessons learned process
27	6-8.05.09	3	PM planning processes
28	15-16.06.09	2	Processes stability improvement
29	29-30.06.09	2	Knowledge management, lessons learned process
30	9-10.07.09	2	Processes stability improvement

ID	Date	Days	Major topic or data source
31	26-28.08.09	3	PM planning processes
32	31.08-2.09.09	3	PM planning processes
33	3-4.09.09	2	Processes stability improvement
34	14-16.09.09	3	PM planning processes
35	28-29.09.09	2	Estimating and budgeting
36	19-20.10.09	2	PM planning processes
37	28-30.10.09	3	PM planning processes
38	16.11.09	1	Knowledge management, lessons learned process
39	17-18.11.09	2	Best PMMs practices
40	19-20.11.09	2	Processes stability improvement
41	23-25.11.09	3	PM planning processes
42	26-27.11.09	2	Processes stability improvement
43	30-1.12.09	2	Processes stability improvement
44	2-4.12.09	3	Processes stability improvement
45	10-11.12.09	2	PM planning processes
46	17-18.12.09	2	Estimating and budgeting
47	7-8.01.10	2	Processes stability improvement
48	11-13.01.10	3	PM planning processes
49	14-15.01.10	2	PM planning processes
50	18-20.01.10	3	Planning processes for portfolio and programme management
51	25-27.01.10	3	Planning processes for portfolio and programme management
52	1-2.02.10	2	Estimating and budgeting
53	9.02.10	1	Knowledge management, lessons learned process
54	10-12.02.10	3	PM planning processes
55	17.02.10	1	Knowledge management, lessons learned process
56	18-19.02.10	2	Knowledge management, lessons learned process
57	23.02.10	1	Conference
58	24-26.02.10	3	PM planning processes
59	1-3.03.10	3	PM planning processes
60	4-5.03.10	2	Estimating and budgeting
61	10.03.10	1	Planning processes for portfolio and programme management
62	18.03.10	1	Knowledge management, lessons learned process
63	22-24.03.10	3	PM planning processes
64	29-30.03.10	2	Estimating and budgeting
65	31.03-1.04.10	2	Processes stability improvement
66	21-23.04.10	3	Processes stability improvement
67	26-27.04.10	2	Best PMMs practices
68	28.04.10	1	Knowledge management, lessons learned process
69	29-30.04.10	2	Best PMMs practices
70	10-12.05.10	3	Best PMMs practices
71	19-21.05.10	3	PM planning processes
72	25-27.05.10	3	Knowledge management, lessons learned process

ID	Date	Days	Major topic or data source
73	21-22.06.10	2	Best PMMs practices
74	23-25.06.10	3	Processes stability improvement
75	12-13.07.10	2	Processes stability improvement
76	9-10.08.10	2	Estimating and budgeting
77	16-17.08.10	2	Processes stability improvement
78	18-20.08.10	3	PM planning processes
79	14-16.09.10	3	PM planning processes
80	17.09.10	1	Conference
81	23.09.10	1	Knowledge management, lessons learned process
82	27-28.09.10	2	Processes stability improvement
83	29.09-1.10.10	3	PM planning processes
84	4-6.10.10	3	PM planning processes
85	7-8.10.10	2	Estimating and budgeting
86	27-29.10.10	3	PM planning processes
87	3-5.11.10	3	Planning processes for portfolio and programme management
88	8-9.11.10	2	Estimating and budgeting
89	15-16.11.10	2	Processes stability improvement
90	17-19.11.10	3	Processes stability improvement
91	24.11.10	1	Knowledge management, lessons learned process
92	25.11.10	1	PM planning processes
93	26.11.10	1	Best PMMs practices
94	29-30.11.10	2	Estimating and budgeting
95	8-10.12.10	3	PM planning processes
96	13-14.12.10	2	Processes stability improvement
97	10.01.11	1	Knowledge management, lessons learned process
98	11-13.01.11	3	PM planning processes
99	17-18.01.11	2	Estimating and budgeting
100	26-28.01.11	3	Knowledge management, lessons learned process
101	1-3.02.11	3	Planning processes for portfolio and programme management
102	7-8.02.11	2	PM planning processes
103	16-17.02.11	2	Processes stability improvement
104	21-22.02.11	2	Planning processes for portfolio and programme management
105	9.03.11	1	Processes stability improvement
106	10-12.03.11	3	Processes stability improvement
107	17-18.03.11	2	Best PMMs practices
108	29-30.03.11	2	Processes stability improvement
109	6-8.04.11	3	Processes stability improvement
110	10.04.11	1	Knowledge management, lessons learned process
111	11.04.11	1	Knowledge management, lessons learned process
112	18-19.04.11	2	PM planning processes
113	28-29.04.11	2	Estimating and budgeting
114	9-10.05.11	2	Best PMMs practices

ID	Date	Days	Major topic or data source
115	11-12.05.11	2	Estimating and budgeting
116	8.06.11	1	PM planning processes
117	9-10.06.11	2	Processes stability improvement
118	15-17.06.11	3	Processes stability improvement
119	11.07.11	1	Knowledge management, lessons learned process
120	8-10.08.11	3	Knowledge management, lessons learned process
121	11-12.08.11	2	PM teams – motivation management
122	16-18.08.11	3	PM planning processes
123	25-26.08.11	2	PM planning processes
124	23.09.11	1	Processes stability improvement
125	27-28.09.11	2	Planning processes for portfolio and programme management
126	3-7.10.11	5	Planning processes for portfolio and programme management
127	10-12.10.11	3	Processes stability improvement
128	24-25.10.11	2	Estimating and budgeting
129	14.11.11	1	Knowledge management, lessons learned process
130	30-2.11.11	3	Knowledge management, lessons learned process
131	5-6.12.11	2	Agile PM
132	12-13.12.11	2	Planning processes for portfolio and programme management
133	14-16.12.11	3	PM planning processes
134	19-21.12.11	3	Processes stability improvement
135	9-10.01.12	2	Planning processes for portfolio and programme management
136	11-13.01.12	3	PM planning processes
137	17-19.01.12	3	Planning processes for portfolio and programme management
138	14.02.12	1	Planning processes for portfolio and programme management
139	15-17.02.12	3	Processes stability improvement
140	20-21.02.12	2	OB3
141	22-33.02.12	2	OB3
142	1-2.03.12	2	Planning processes for portfolio and programme management
143	5-6.03.12	2	Planning processes for portfolio and programme management
144	9.03.12	1	Processes stability improvement
145	12-14.03.12	3	PM planning processes
146	20-21.03.12	2	OB3
147	22-23.03.12	2	OB3
148	26-27.03.12	2	Planning processes for portfolio and programme management
149	28-29.03.12	2	Planning processes for portfolio and programme management
150	30.03.12	1	Processes stability improvement

ID	Date	Days	Major topic or data source
151	2-3.04.12	2	Planning processes for portfolio and programme management
152	16-17.04.12	2	OB3
153	24-25.04.12	2	OB3
154	26-27.04.12	2	OB3
155	11.05.12	1	Processes stability improvement
156	16-17.05.12	2	Processes stability improvement
157	21-22.05.12	2	OB3
158	28-29.05.12	2	Processes stability improvement
159	30-31.05.12	2	Processes stability improvement
160	12-13.06.12	2	OB3
161	14-15.06.12	2	Planning processes for portfolio and programme management
162	28-29.06.12	2	OB3
163	5-7.09.12	3	Processes stability improvement
164	24-26.09.12	3	PM planning processes
165	15-17.10.12	3	PM planning processes
166	23-24.10.12	2	OB3
167	25-26.10.12	2	OB3
168	6-7.11.12	2	OB3
169	8-9.11.12	2	OB3
170	15-16.11.12	2	OB3
171	21-23.11.12	3	Processes stability improvement
172	3-4.12.12	2	PM planning processes
173	10-11.12.12	2	PM planning processes
174	20-21.12.12	2	Project risk management
175	8-9.01.13	2	OB3
176	10-11.01.13	2	OB3
177	15-16.01.13	2	Project risk management
178	17-18.01.13	2	PM planning processes
179	28-30.01.13	3	PM planning processes
180	31.01-1.02.13	2	Planning processes for portfolio and programme management
181	6-7.02.13	2	Planning processes for portfolio and programme management
182	28.02-1.03.13	2	Estimating and budgeting
183	5-6.03.13	2	OB3
184	25-27.03.13	3	PM planning processes
185	15-16.04.13	2	PM planning processes
186	17-18.04.13	2	Processes stability improvement
187	19-20.04.13	2	Estimating and budgeting
188	22-24.04.13	3	PM planning processes
189	25-26.04.13	2	PM planning processes
190	6-7.05.13	2	Estimating and budgeting
191	8-10.05.13	3	PM planning processes

ID	Date	Days	Major topic or data source
192	16-17.05.13	2	OB3
193	4-5.06.13	2	Planning processes for portfolio and programme management
194	10-11.06.13	2	Processes stability improvement
195	19.06.13	1	Knowledge management, lessons learned process
196	20-21.06.13	2	OB3
197	2-3.07.13	2	PM planning processes
198	4-6.09.13	3	Processes stability improvement
199	9-11.09.13	3	Processes stability improvement
200	10-11.10.13	2	OB3
201	12-13.11.13	2	PM planning processes
202	18-19.11.13	2	Planning processes for portfolio and programme management
203	27-29.11.13	3	PM planning processes
204	16-18.12.13	3	PM planning processes
205	27-28.01.14	2	PM planning processes
206	24-26.03.14	3	OB3
207	14-15.04.14	2	PM planning processes
208	12-14.05.14	3	PM planning processes
209	15-16.05.14	2	Estimating and budgeting
210	22-23.05.14	2	PM planning processes
211	26-27.05.14	2	PM planning processes
212	4-5.06.14	2	PM planning processes
213	25-26.06.14	2	Estimating and budgeting
214	25-27.08.14	3	PM planning processes

Appendix 6: "Stream – 2", PM community debriefing

The table below illustrates the essential characteristics of "Stream – 2", i.e. the debriefing of the framework concept with the PM community and the discussions of the framework concept conducted with groups of PM practitioners. Some of the topics identified appeared very early in the course of communicating the research project to the PM community, others occurred in more advanced phases when the framework started to take firm shape. Thus the table contains elements ranging from requirements to commentaries, questions to criticism and sometimes even compliments. Comments and issues that addressed similar concerns have been given generalized descriptions (topic/meaning), sometimes supported with additional commentary. A significance level was assigned to each (column Sig) indicating in how many meeting-days the specific topic was raised. Such generalized topics/meanings were subsequently grouped together and listed alphabetically according to the group.

Topic/meaning and additional commentary	Sig	Group
I can confirm overestimations and underestimations have been identified on the same projects.	65	Acceptance or reflection
I have never managed to get to know the whole description of any PM methodology. This concept (framework) is easier to understand.	24	
I recognize clarity in goal to improve accuracy of estimates as it clearly differentiates it from repetitive processes.	19	
I will rethink assumptions of the critical chain method again.	18	
Indeed, can you imagine that even if obvious I have never asked myself why critical chain is so focused on safety margins and overestimations? In reality we also have underestimations.	57	
Joint consideration of project context and tools, accuracy of estimates and knowledge management is an interesting approach.	153	
There is clarity in explaining the major root of many PM techniques – necessity to manage estimation bias. Commentary: clarity understood as the differentiation from repetitive process.	12	
This is similar to agile PM, adaptable. But the goal is different. Commentary: the goal is improvement of the accuracy of estimates.	6	
We have similar perception of the role the project context could play. However, it was not turned into a framework and not focused on accuracy of estimates.	197	

We used to learn many different methodologies – this framework would be rather a shared by many approach.	26	
Ability to consider contextual factors typical to our business. Commentary: adaptability must be clearly expressed and supported.	58	Adaptability to the project context
Contextual and tools dimensions of the framework should be adaptable to the encountered situation – business context.	297	
Do not make "the final best" solution, over-generalized. Keep it open to needs and requirements. Commentary: requirements relate to knowledge developed by the project teams. Solution should become their framework, not simply imposed on them.	95	
It must adapt to us – not us to the framework.	64	
How does framework relate to other methodologies? Commentary: this question considers the major PMMs.	8	Comparisons to other PMMs
Risks associated with implementation must be lower than in case of traditional methodologies.	9	
What cost may be associated with implementation in comparison to other methodologies?	38	
Will framework present a large file like, for example, PMBOK or is this something different? Commentary: an unwelcome possibility.	45	
For dependencies between tools and project context, I would not use "+", "++" or "-". I would prefer some scale as, for example, from one to ten. Commentary: here many various ideas to depict relations between tools and project context were discussed.	59	Development of the framework
Framework focuses on accuracy of estimation and its improvement. What new model to calculate buffers could be proposed? Commentary: it considers underestimated and overestimated activities identifiable in one project schedule. Buffer calculation method, as an objective, was outside the research project's scope.	162	
Framework is focused on the need to improve accuracy of estimates. Could other performance indicators be used instead?	22	
How do you plan to develop the topic further?	62	
I am not sure I think that you could group some techniques (i.e. rows) and project contexts (i.e. columns), or change their sequence. Commentary: there were no clear, repeatable indications of what exactly should be altered, just that it could look better.	49	
I would like to alter the list of proposed tools and techniques.	185	

You could add a third dimension to the framework. Commentary: this commentary appeared quite often and various “variables” as the third dimension were proposed, e.g. project type, functional location in organization, success rate of making use of specific techniques, extent to which technique is shared in organization, mark to report technique-usage to lessons learned to further adopt framework.	112	
Could you put the whole framework layout into IT form and provide some sort of voting system to drive its further development? Commentary: this “voting” system considers relations between tools and context triggering their use.	8	Development of the framework – software
You could propose IT support to the workflow – to guide step-by-step implementation process.	27	
You should consider the development of some “platform”, maybe software, tracking changes applied to the framework during its use. Commentary: it considers knowledge management as the framework remains adaptable and thus evolves.	23	
Discussing tools, techniques, project context and PM methodologies. Commentary: it happened during each meeting. However, the intention was not to substitute the formal conceptualization process presented in Chapter 5, based on the use of conceptual network development data sources. The researcher emphasized “Stream – 2” to be mainly an element of the communication of the framework with PM practitioners, getting to know the PM practice, identifying valuable interviewees and also to mitigate risks related to achieved deliverable i.e. the framework.	407	Development of the researcher
Ease of understanding is a “must have” of the framework.	62	Ease of understanding and use
I like that this is simple. I do not have a lot of time at my work to follow complex guidance.	27	
Keep the framework as a two-dimensional layout.	41	
Make it a “one-page” framework.	16	
Make the framework short and simple. We have enough of complex procedures.	157	
Ensure that this framework will accept existence of other PM methodologies. Do not act against them.	28	Implementation
Discuss the sequence and organization of the implementation and what should be done at the beginning.	196	
How prescriptive is the framework? Is this “to be followed” or more “to be customized”?	38	
How much time does it take to implement the framework? Commentary: the expectation is to have a short implementation project.	325	
In comparison to major PM methodologies the process of implementation, we hope, will be easier to understand.	49	

It may be necessary to establish one centre in organization which will focus on promoting this idea; it may be policy similar to our lean implementation project.	11	
Minimal prerequisites to make use of the framework?	83	
Should placement within functional structure be centered in, for example, PMO, or rather be “scattered” to a variety of locations?	26	
The first step of implementation should verify users' perception of the idea for the framework. Commentary: in opinion of the researcher it considered present paradigm.	57	
Framework should be considered as an element of our overall knowledge management policy. Commentary: it considered not only the knowledge collected through doing projects.	208	Knowledge management
Please define what is the lessons learned process and its role in altering this framework. Commentary: it appeared that perception of what lessons learned actually is may be unclear.	72	
The aspect I like is that the framework continuously makes use of our knowledge generated through projects and lessons learned.	47	
What institution will support this framework if questions arise?	7	Maintenance
Do you publish on the topic?	16	Publicity
You must discuss the idea for the framework, e.g. during PM conferences.	21	
Do you think that the framework can be successful in PM market dominated by other methodologies? Commentary: as, “we doubt”.	39	Risks
How to facilitate different opinions on the tools and their dependencies to the project context? What to do if conflict appears?	3	
I do not understand – repeat the description please.	11	
I hope that our management will start to think contextually; they prefer to focus on PM organizations.	49	
It is interesting whether there are some industries or business sectors where application of this framework may not be possible.	18	
The problem I recognize – there is need to shift the way we are thinking of PM.	63	
They will not accept it. Our PM methodology is already well defined. Commentary: “they” refers to decision makers.	36	
Will framework openness not lead to chaos? In one company various approaches may be developed on the basis of one adaptable framework.	92	
Will not the educational requirements to make use of the framework be too high?	7	

You have to pay attention to the background and characteristics of people that you will address with this framework. Commentary: this was a frequently raised issue. PM practitioners considered: age, prior formal education in PM, position held at the company, relation to change management or continuous improvement, membership and certification in any PM organization.	60	
This deliverable is part of the DBA project? What is DBA?	146	Unclassified
Do you have references related to some company making use of the proposed framework?	123	Verification in PM practice
Have you tested this framework?	38	
How much is the framework focused on theory and how much on practice? Commentary: in the culture (Germany and especially Poland) where the majority of data was collected, the word “theory” may have a negative connotation. For example, during conferences the word “theory” is generally avoided.	57	